FARR

TECHNICAL MANUAL

KT-20000

20” (50.8 cm) 50K Lbs.-Ft.

Hydraulic Power Tong

- *Specifications*
- *Operation*
- *Maintenance*
- *Assembly*

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MCCOY
MOVING GLOBAL ENERGY FORWARD

This manual covers the following models:

TONG MODEL	REV	DESCRIPTION
80-1302	2	Tong is equipped with Rineer 125-82 motor, motor valve, lift cylinder valve, and chain sling.
80-1302-1	2	Tong is equipped with Rineer 125-82 motor, motor valve, lift cylinder valve, chain sling, and safety door.
80-1302-2	4	Tong is equipped with Staffa B080 motor, motor valve, lift cylinder valve, chain sling, and safety door.
80-1303	2	Tong is equipped with Staffa B080 motor, motor valve, and chain sling.
80-1304	2	Tong is equipped with Staffa B080 motor, motor valve, lift cylinder valve, and chain sling.

NOTE: **Some illustrations used in this manual may not exactly match your equipment.**

PATENTED & PATENTS PENDING

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McCoy has made every effort to ensure the information contained in this document is accurate and current. This manual is intended to provide equipment operation and safety instructions for your equipment. However, McCoy does not warrant or guarantee that the information is either complete or accurate in every respect and the user of the manual should consult with its McCoy sales representative for any clarifications and updates.

The user of the manual shall protect, indemnify, and hold harmless McCoy and its directors, officers, employees, and agents from and against all liability for personal injury, death, or property damage resulting directly or indirectly from the use of the information contained in this manual.

Observance of all descriptions, information and instructions set out in this manual is the full responsibility of the user. This manual is intended for guidance and informational purposes and must be used in association with adequate training and on-the-job supervision to provide safe and effective equipment use.

It is the responsibility of the user to conform to all regulations and requirements issued by an authority or agency which may affect the operation, safety or equipment integrity, that may overrule the content of this documentation.

The user will acknowledge and obey any general legal or other mandatory regulation in force relating to accident prevention, safety, and equipment integrity.

Summary Of Revisions

Date	Section	Page	Description Of Revision
June 2007	N/A	N/A	Initial Release
Oct 2007	Intro	iii	Added list of tong models covered by this manual
	Intro	v	Added Warnings
	4	4.9	Added torque table for load-bearing components
Dec 2007	7	7.15	Corrected part numbers for items B, J, & L
June 2011	All	All	Re-branded manual
	Intro	ix	Added Table of Illustrations
	All	All	Improved warnings throughout manual
	2		Moved "Assembly Instructions" to "Maintenance" section, Section 2 becomes "Setup & Operation"
	2	2.1	Added Section "Sling & Load Bearing Device Safety".
	2	2.8	Replaced hydraulic schematic & hydraulic B.O.M.
	2	2.9	Added hydraulic component identification graphics
	2	2.13	Added Section "Tong Rig-up & Leveling".
	2	2.17	Replaced "valve operation" graphics
	2	2.18	Added Subsection "Shifting Gears".
	2	2.19	Added Section " Making & Breaking Connections".
	3		Renumbered Maintenance Section as Section 3
	3	3.1	Added Section "General Maintenance Safety Practices".
	3	3.1	Added Section "Preventive Maintenance Practices".
	3	3.2 - 3.6	Replaced lubrication point graphics
	3	3.8	Added Subsection "Door Alignment".
	3	3.8	Added Subsection "Shifter Detent Force Adjustment".
	3	3.12 - 3.21	Added Section "Assembly Procedures".
	3	3.22	Added Section "Daily Power Tong Inspection & Maintenance".
	3	3.24	Added Section "Monthly Power Tong Inspection & Maintenance".
	3	3.27	Added Section "Daily Power Unit Inspection & Maintenance".
	3	3.28	Added Section "Tubular Connection Equipment De-commissioning".
	3	3.31	Added Section "Tubular Connection Equipment Re-commissioning".

Continued On Next Page

Summary Of Revisions (Continued)			
Date	**Section**	**Page**	**Description Of Revision**
June 2011	4		Renumbered "Troubleshooting" section as Section 4
			Removed old section "Storage Recommendations" (see Maintenance section, Equipment de-commissioning & Equipment re-commissioning).
	5		Renumbered "Assemblies & Parts" section as Section 5
	5	5.2 - 5.3	Replaced "Gear Train Layout" images with current versions.
	5	5.4 - 5.5	Updated Support Roller graphics & BOM to reflect current version
	5	5.6 - 5.7	Updated Door Pivot Roller graphics & BOM to reflect current version
	5	5.18 - 5.19	Removed Tong Body graphics & BOM, inserted Hydraulic Supports & Hanger Legs graphics and BOM.
	5	5.20 - 5.21	Removed existing graphics, inserted Motor Options graphics & BOM.
	5	5.22 - 5.23	Updated Brake Band graphics & BOM to reflect current version
	5	5.28 - 5.29	Updated Door Assembly graphics & BOM to reflect current version
	6	All	Complete revision of torque measurement section
Jan 2012	All	All	Updated manual to conform to current branding standards.
	1	1.3	Corrected specifications
	2	2.12	Added jaw die kits to list of available kits
	5	5.22	Inserted diagrams & BOM - torque gauge mounts

WARNINGS

A "LOAD-BEARING DEVICE" IS A CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT FOR WHICH THIS MANUAL HAS BEEN PRODUCED

THE LOAD-BEARING DEVICE SUPPLIED BY MCCOY DRILLING & COMPLETIONS IS DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO LIFT OR SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL IF THERE ARE ANY MODIFICATIONS TO THE LOAD-BEARING DEVICE, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

WHEN RE-ASSEMBLING LOAD-BEARING DEVICES (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS, ETC.) NOTE THAT THE ASSOCIATED FASTENERS MUST BE TIGHTENED TO THE CORRECT TORQUE SPECIFIED FOR THAT SIZE OF FASTENER (SEE SECTION 3 - OVERHAUL). ANY THREADED FASTENER IN A LOAD-BEARING DEVICE MUST BE SECURED WITH RED OR BLUE LOCTITE™.

ANY REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

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The information presented in this document will provide setup, operating, and maintenance instructions for your KT-20000 tong. Due to the wide variety of operating conditions, these instructions must be considered guidelines rather than absolute operating procedures. It is the responsibility of the user to use these guidelines together with an experienced manager to develop operating procedures that conform to all policies set forth by the operating authority (ies).

IDENTIFICATION OF WARNINGS AND OTHER NOMENCLATURE OF IMPORTANCE USED IN THIS TECHNICAL MANUAL

Farr Canada Corp. uses three indicators to describe items of three degrees of importance.

*A **HAZARD** to operators or equipment is represented by an exclamation point within a red triangle. identifies items of the highest importance. Failure to heed information identified by a **HAZARD** symbol may result in bodily injury, death, catastrophic equipment damage, or any combination of these. A **HAZARD** may also indicate the potential for dangerous environmental contamination.*

This identifies a HAZARD to operators or equipment

*A **WARNING** is represented by an exclamation point within an orange triangle, and contains information that will alert personnel to a potential safety hazard that is not life-threatening. A **WARNING** may also serve to alert the user to information critical to the correct assembly or operation of the equipment in use.*

This identifies a WARNING to users

*A **CAUTION** is represented by an exclamation point within a yellow triangle and highlights information that may aid the user during assembly or operation of your equipment. CAUTIONs are also used to ensure common errors are not made during assembly or operation of your equipment.*

This identifies a CAUTION to users

Observance of the following is the full responsibility of the user:

- ***all descriptions, information and instructions set out in this manual***
- ***any regulation or requirement issued by an authority or agency which may influence operation, safety or integrity of the equipment that overrules the content of this document.***
- ***any legal or other mandatory regulation in force governing accident prevention or environmental protection.***

Congratulations on the purchase of your FARR® KT-20000 20" tong. This unit will provide you with years of outstanding performance. Simple maintenance and care will extend its life and ensure years of excellent performance and reliability. The setup, operating, and maintenance instructions in this manual will assist you in giving your equipment the care it requires. Please carefully read the manual before installing and using your equipment. Replacement parts are readily available from McCoy Drilling & Completions | Farr in Edmonton, Alberta. Note that many parts are transferable between FARR® tongs and backups. Should you need replacement parts, or should you experience any difficulty not covered in this manual, please contact:

McCoy Drilling & Completions | Farr

14755 121A Avenue
Edmonton, Alberta
Canada T5L 2T2
Phone: 780.453.3277
Fax: 780.455.2432

Sales Fax: 780.481.9246
Email Engineering: engFarr@mccoyglobal.com
Email Sales: salesFarr@mccoyglobal.com

Website: http://www.mccoyglobal.com/index.php/drilling-completions

ILLUSTRATION 1.A.1: KT-20000 TONG

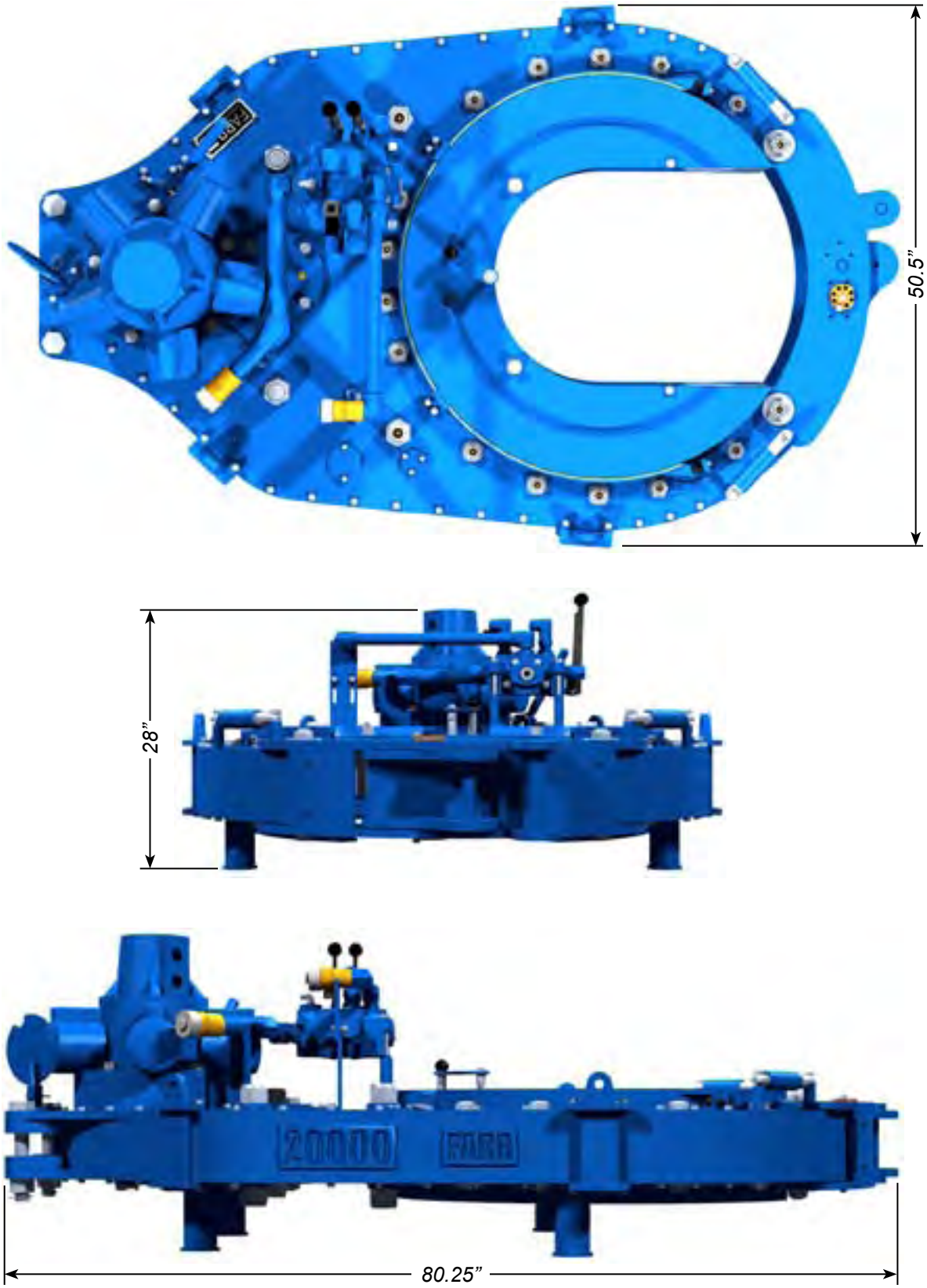


ILLUSTRATION 1.A.2: KT-20000 POWER TONG DIMENSIONS

Available Torque - Staffa HMB 80 Motor

Pressure		High Gear		Low Gear	
PSI	MPa	Lbs-Ft.	NM	Lbs-Ft.	NM
1000	6.895	2500	3390	15800	21422
1500	10.34	4200	5694	27400	37149
2000	13.79	6000	8135	39100	53012
2500	17.24	7800	10575	50700	68740
MAXIMUM RATED TORQUE: 50000 LBS.-FT. (67790 NM)					

Available Torque - Rineer GA125 Motor

Pressure		High Gear (lbs.-ft.)		Low Gear (lbs.-ft.)	
PSI	MPa	Lbs.-Ft.	Nm	Lbs.-Ft.	Nm
1000	6.895	2300	3118	14600	19795
1500	10.34	3900	5288	25500	34573
2000	13.79	5600	7593	36300	49216
2650	18.27	7700	10440	50300	68198
MAXIMUM RATED TORQUE: 50000 LBS.-FT. (67790 NM)					

Available Speed - Staffa HMB 80 Motor

Flow (USGPM/LPM)	Low Gear (RPM)	High Gear (RPM)
10	1	8
20	3	17
40	5	32
60	7	49

Available Speed - Rineer GA125 Motor

Flow (USGPM/LPM)	Low Gear (RPM)	High Gear (RPM)
10	1	8
20	2	16
40	5	32
60	7	49

Hydraulic Requirements (max.): 60 US GPM (227 LPM)
3000 PSI (20.684)

Max Length: 80.25" inches / 203.8 cm (doors closed)

Height (Staffa Motor): 28" / 71.1 cm (chain sling not included)

Height (Rineer Motor): 25-3/8" / 64.5 cm (chain sling not included)

Overall Width: 50.5" inches / 128.3 cm

Space Required on Pipe: 10" / 25.4 cm

Maximum Elevator Diameter: N/A

Torque Arm Length: 52 inches / 132.1 cm - Centre line of pipe to centre line of anchor -

Weight (Approximate): 3400 lb. / 1545 kg.

Casing Jaws Available (inches): 7" to 20" (See Pg. 2.12)

Recommended Spring Hanger: 85-0106XXH (Capacity = 3500 Lbs.)

REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) MUST BE GRADE 8 OR EQUIVALENT (WHERE REQUIRED).

Use an EP synthetic grease that meets or exceeds the following specifications:

Thickener	Lithium Complex
NLGI consistency grade	2
NLGI performance grade	GC-LB
Penetration - ASTM D 217 (25°C [77°F]	265-295 minimum (0.1 mm) worked 60 strokes
Dropping point, °F[°C] - ASTM D2265	550 [288] minimum
High temperature life, hours - ASTM D 3527	160 minimum
Oxidation stability, psi - ASTM D 942	(100 hr/300 hr) 0/3
Water washout, percent - ASTM D 1264	1.8 max
Rust and corrosion - ASTM D 1743	pass
Oil separation, percent loss - ASTM D 1742	1.1 max (24 hours, 25°C [77°F]
Leakage, g lost - ASTM D 4290	1.0 max
Four ball wear test, mm scar - ASTM D 2266	0.40 max
Fretting wear, mg - ASTM D 4170	3.4 max
Four ball EP, kgf - ASTM D 2596	
Weld point	400 minimum
Load wear index	50 minimum
Timken OK load test, lbs - ASTM D 2509	50
Low temperature torque, N*m - ASTM D 4693	1.3 max (-40°C [-40°F])
LT-37 pumpability, g/min	360/7 (60°F/0°F [16°C/-18°C])
Copper corrosion - ASTM D 4048	1B
Disc brake wheel bearing specifications	
Ford ESA-M1C 198A	Yes
Chrysler MS-3701	Yes
Oil viscosity: 40°C [104°F], cSt	151
100°C [212°F], cSt	19.2
Flash point, °F[°C] - ASTM 92	450[232]

Use a premium quality hydraulic fluid that meets or exceeds the following specifications:

Typical Density (kg/m3)	878
Viscosity - cSt @ 40 °C	68.8
- cSt @ 100 °C	8.7
Viscosity Index	97
Pour Point °F [°C]	-22 [-30]
Flash Point °F [°C]	432 [222]
Colour, ASTM	1.5
Neutralization Number	0.40
Rust Protection - Distilled Water	No Rust
- Sea Water	No Rust
Hydrolytic Stability - Cu Mass Loss, mg/cm2	0.04
Copper Corrosion Test	1A
Filterability: Denison - Wet & Dry	Pass
Afnor - Wet & Dry	Pass
Cincinatti Milacron Spec Approved	P69
Denison HF-0:	Approved
Denison P-46 Piston Pump:	Pass
Denison T6C Vane Pump:	Pass
Vickers 35VQ25 Vane Pump Test:	Pass
104/105C Vane Pump Test:	No Data Available
Vane pump test total ring and vane wear, mg.	<10
Oxidation Stability	
Turbine Oil Stability Test Life, hours	2500+
Rotary Bomb Oxidation Test, minutes	325
FZG Spur Gear Test, Failure Load Stage (FLS)	12

Adequate setup and proper hydraulic connections are essential in ensuring reliable operation of your tong. For best results and long term reliability, read and obey the start-up instructions in this section.

DO NOT ACCESS ROTATING COMPONENTS UNLESS HYDRAULIC POWER SUPPLY HAS BEEN DEACTIVATED OR ISOLATED.

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

A. SLING / LOAD BEARING DEVICE SAFETY

THE SUPPLIED LOAD-BEARING DEVICE (CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT DESCRIBED IN THIS MANUAL) HAS BEEN SPECIFIED OR DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS DOCUMENT. FARR WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

MCCOY DRILLING & COMPLETIONS DOES NOT GUARANTEE THE INTEGRITY OF MODIFIED OR DAMAGED LOAD-BEARING DEVICES, UNLESS THOSE MODIFICATIONS ARE PERFORMED BY MCCOY DRILLING & COMPLETIONS.

McCoy Drilling & Completions recommends following an industry-accepted standard such as OSHA, ASME B30.9-2006, or manufacturer's guidelines when performing any rigging and overhead lifting. Use by untrained persons is hazardous. Improper use will result in serious injury or death. Do not exceed rated capacity. Slings will fail if damaged, abused, misused, overused, or improperly maintained.

- *Only grade 80 or grade 100 alloy chain should be used for overhead lifting applications.*
- *Working Load Limit (WLL) is the maximum allowable load in pounds which may be applied to the load-bearing device, when the device is new or in "as new" condition, and when the load is uniformly and directly applied. The WLL must never be exceeded.*
- *Working Load Limit (WLL) is the maximum working load for a specific minimum sling angle, measured from the horizontal plane. The Working Load Limit is identified on the sling.*
- *The Working Load Limit or Design factor may be affected by wear, misuse, overloading, corrosion, deformation, intentional alterations, sharp corner cutting action and other use conditions.*
- *Shock loading and extraordinary conditions must be taken into account when selecting alloy chain slings.*
- *See OSHA Regulation for Slings 1910.184, ANSI/ASME B30.9-"SLINGS", ANSI/ASME B30.10-"HOOKS" and ANSI/AMSE B30.26 "RIGGING HARDWARE" for additional information.*

THE MINIMUM SLING ANGLE (THE ANGLE OF THE LEG OF THE SLING MEASURED FROM THE HORIZONTAL) MUST NEVER FALL LOWER THAN THE ANGLE SPECIFIED FOR THE SLING IN USE

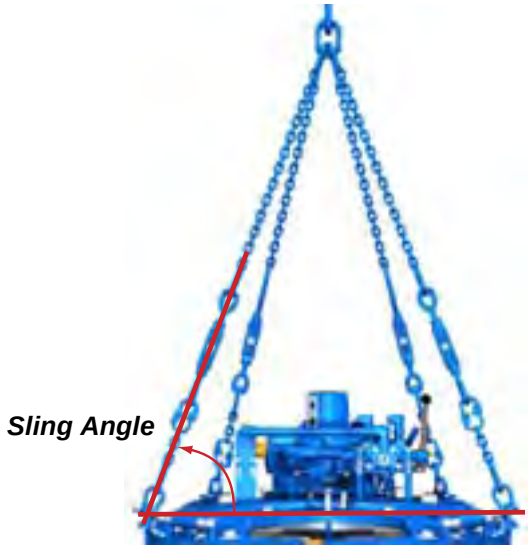


ILLUSTRATION 2.A.1: SLING ANGLE

1. Inspection Of Slings

McCoy Completions & Drilling strongly recommends the following practices:

A complete inspection of new load-bearing devices and attachments shall be performed by a qualified, designated person prior to initial use. Each link and component shall be examined individually, taking care to expose and examine all surfaces including the inner link surface. The sling shall be examined for conditions such as those listed in the removal criteria below. In addition, daily inspection of slings, fastenings and attachments shall be performed by a designated person. If damage or defects are found at either inspection, the damaged or defective component shall be quarantined from service until it can be properly repaired or replaced.

Removal Criteria:

A load-bearing device shall be removed from service if conditions such as the following are present:

- *Missing or illegible sling identification.*
- *Cracks or breaks*
- *Evidence of tampering is seen - sling tag has been modified or obscured, or tamper-proof nuts are missing.*
- *Signs of impact on load-bearing components, including spreader bars, lifting lugs, rigid slings & rigid sling weldments, and legs & leg mounts.*
- *Broken or damaged welds.*
- *Excessive wear, nicks, or gouges. Refer to the chart below to ensure minimum thickness on chain links supplied is not be below the values listed:*

Minimum Allowable Chain Link Thickness at Any Point			
Nominal Chain Size		**Minimum Thickness**	
Inches	MM	Inches	MM
7/32	5.5	0.189	4.80
9/32	7	0.239	6.07
5/16	8	0.273	6.93
3/8	10	0.342	8.69
1/2	13	0.443	11.26
5/8	16	0.546	13.87
3/4	20	0.687	17.45
7/8	22	0.750	19.05
1	26	0.887	22.53
1-1/4	32	1.091	27.71
Refer To ASME B30.9			

- *Stretched, bent, twisted, or deformed chain links or components.*
- *Evidence of heat damage.*
- *Excessive pitting or corrosion.*
- *Lack of ability of chain or components to hinge (articulate) freely.*
- *Weld splatter.*
- *For hooks, removal criteria as stated in ASME B30.10*
- *Other conditions, including visible damage, that cause doubt as to the continued use of the sling.*

Inspect all lugs and fixing points for signs of elongation and/or bending, or for material build-up around the hole. Repair or replace components that appear distorted. Ensure all hardware is tight and in good condition. Replace missing hardware if necessary. All hardware must be free of rust and corrosion.

Additional inspections shall be performed during sling use where service conditions warrant. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on:

- *Frequency of use of the load-bearing device.*
- *Severity of service conditions*
- *Nature of lifts being made*
- *Experience gained on the service life of load-bearing devices used in similar circumstances.*

Guidelines for the interval are:

- *Normal Service - yearly*
- *Severe Service - monthly to quarterly*
- *Special Service - as recommended by a qualified person*

Units designed and manufactured in accordance with EN 12079 and DNV 2.7-1 should be tested and examined in accordance with the following schedule of examination and test. The user of the load-bearing device shall place a permanent placard or plate upon which the type and date of the last test shall be recorded. To avoid confusion, the plate shall not carry the date of the next test or examination, only the most recent.

Test / Examination				
Time / Interval	Lifting Tests[1]	Non-Destructive Examination (NDE) of Lifting Points	Thorough Visual Examination	Suffix To Be Marked On Plate Attached To Unit
Initial Certification By Farr® / Superior	YES	BY REQUEST	YES	T
Interval Not Exceeding 12 Months	At the discretion of inspection body	At the discretion of inspection body	YES	T or VN[3]
Interval Not Exceeding 60 Months	At the discretion of inspection body	YES	YES	T or VN
Following Substantial Repair or Alteration[4]	YES	YES	YES	T

1. Lifting test as per S 7.3 BS EN 12079 or DNV 2.7-1 May 1995
2. T = Proof Test, non-destructive examination; VN = non destructive examination and visual examination; V = visual examination.
3. Dependant upon whether non-destructive examination has been carried out.
4. For the purposes of this standard, a substantial repair or modification is defined as any repair and/or modification that has been carried out which may, in the opinion of the inspection body, affect the load-bearing elements of the container or lifting device, or elements that contribute directly to its structural integrity.

IF MECHANICAL DAMAGE IS SEEN OR SUSPECTED ON A LOAD-BEARING DEVICE, OR IF THE LOAD-BEARING DEVICE HAS BEEN OVERLOADED, IT MUST BE REMOVED FROM SERVICE AND QUARANTINED UNTIL RECERTIFIED

Written records of the most recent periodic inspection shall be maintained, and shall include the condition of the sling.

2. *Proper Use Of Load-Bearing Devices*

Whenever any load-bearing device is used, the following practices shall be observed.

- *Load-bearing devices that are damaged or defective shall not be used.*
- *Slings shall not be shortened with knots or bolts or other makeshift devices.*
- *Sling legs shall not be kinked.*
- *Load-bearing devices shall not be loaded in excess of their rated capacities.*
- *Slings shall be securely attached to their load.*
- *Load-bearing devices shall be protected from snagging, and shall not be further obstructed by any object.*
- *Suspended loads shall be kept clear of all obstruction.*
- *All employees shall be kept clear of loads about to be lifted and of suspended loads.*
- *Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.*
- *Shock loading is prohibited.*
- *Do not stand directly under a load during lifting.*

3. *Storage Of Load-Bearing Devices*

Proper storage of out-of-service load bearing devices is important to ensure full integrity of the device once it is returned to service. Farr® recommends observing the following practices:

- *Wipe off all excess grease. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*
- *Farr® recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces. Refer to manufacturer data sheets for proper application and safety information. Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*
- *Store in a clean, dry location. When returning to service, note that a full inspection of the device must be performed.*

ENSURE CHAINS DO NOT BECOME ENTANGLED IN ANY EQUIPMENT SUPERSTRUCTURE WHEN USING CHAIN SLINGS TO HOIST EQUIPMENT.

B. MAJOR COMPONENT IDENTIFICATION

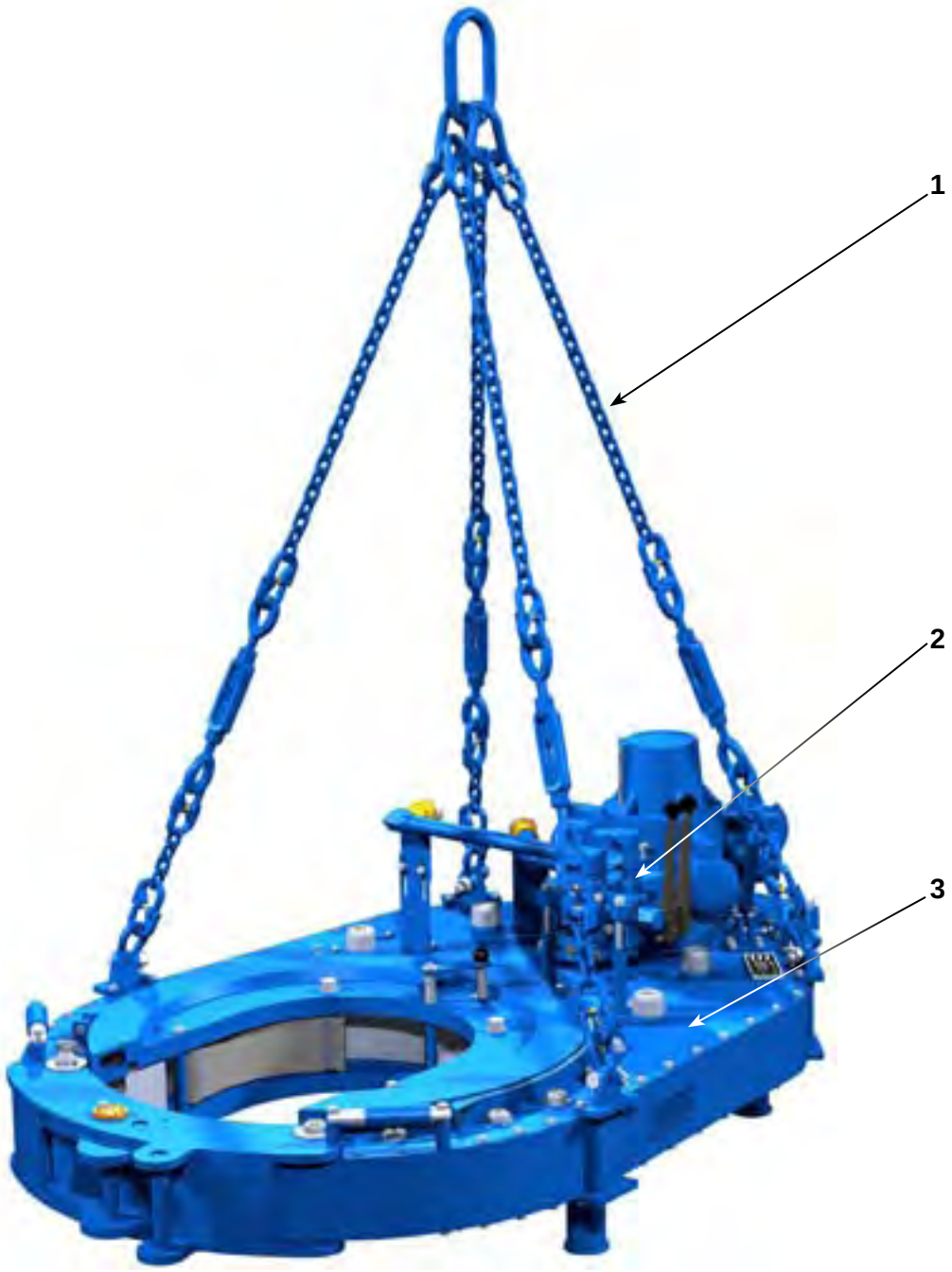


ILLUSTRATION 2.B.1: MAJOR COMPONENT IDENTIFICATION 01

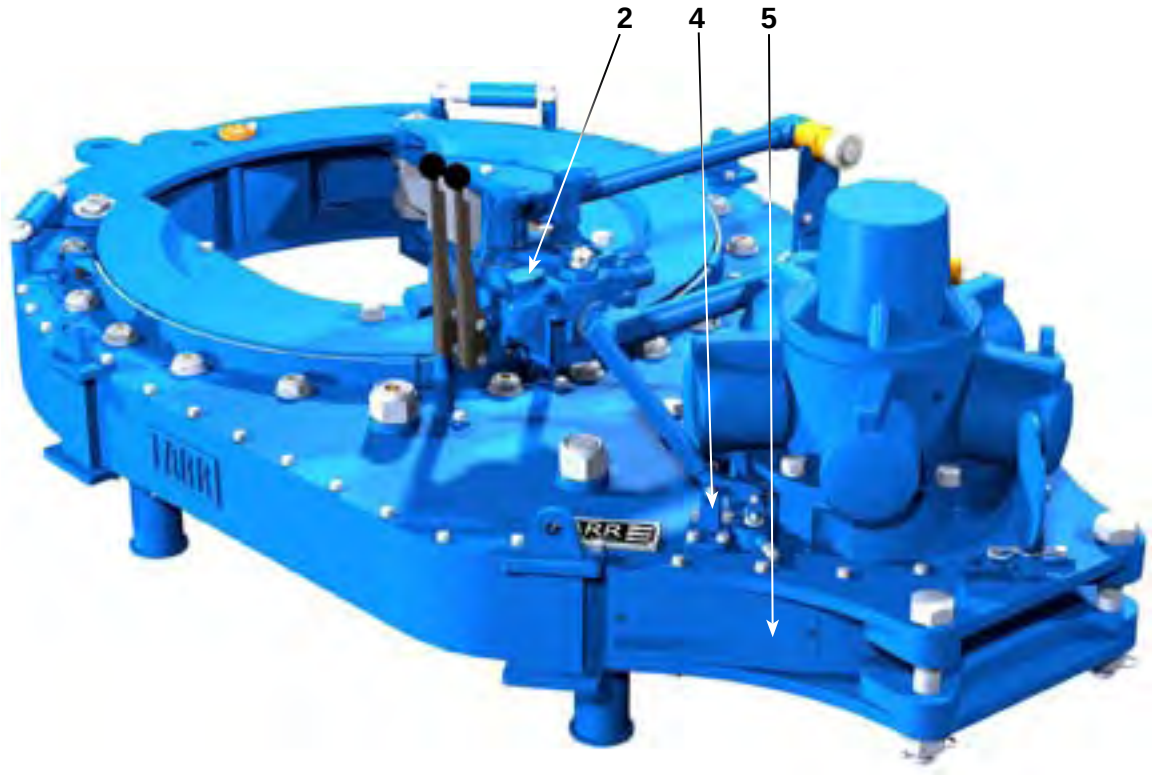


ILLUSTRATION 2.B.2: MAJOR COMPONENT IDENTIFICATION 02

ILLUSTRATION 2.B.3: MAJOR COMPONENT IDENTIFICATION 03

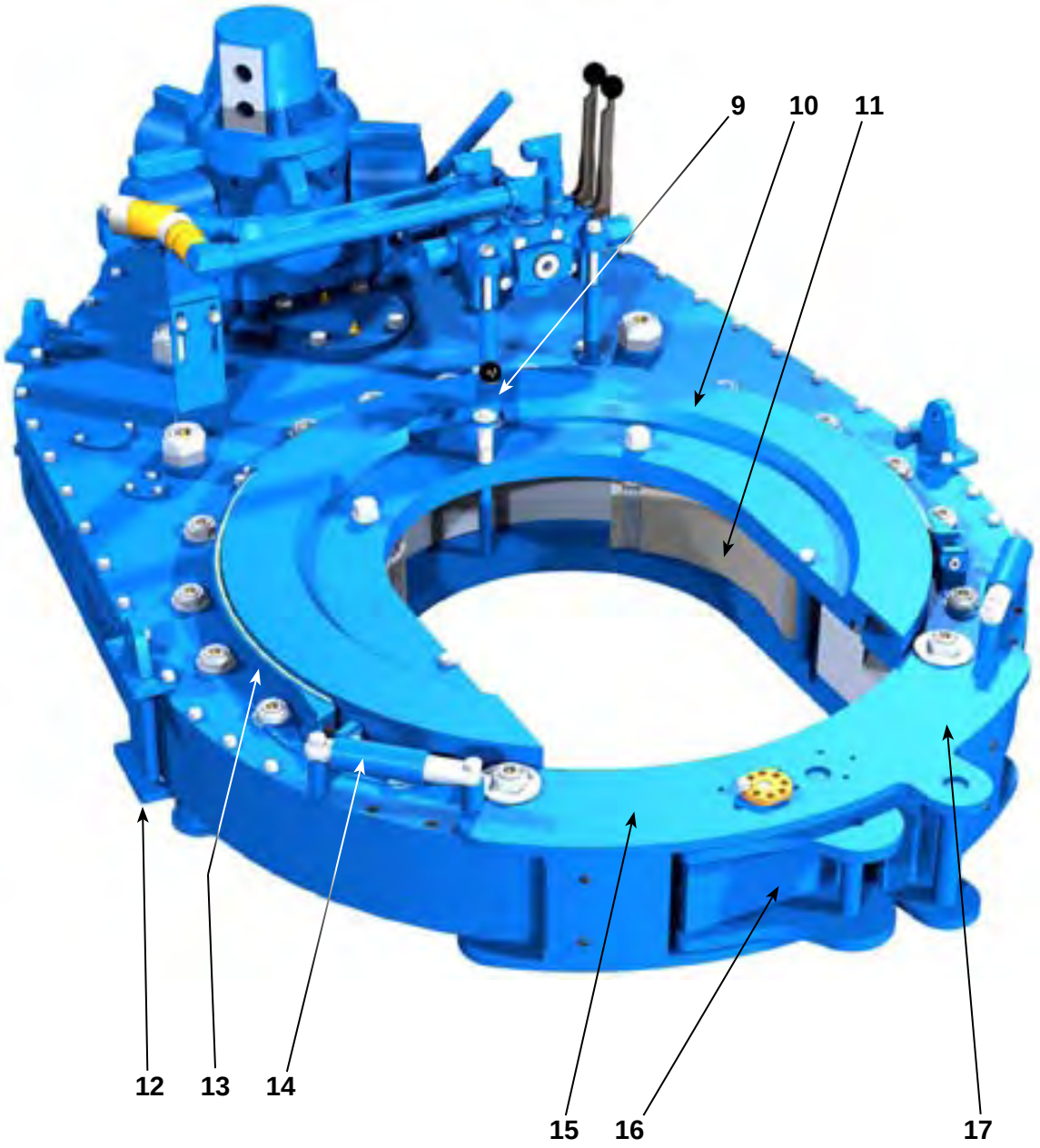


ILLUSTRATION 2.B.4: MAJOR COMPONENT IDENTIFICATION 04

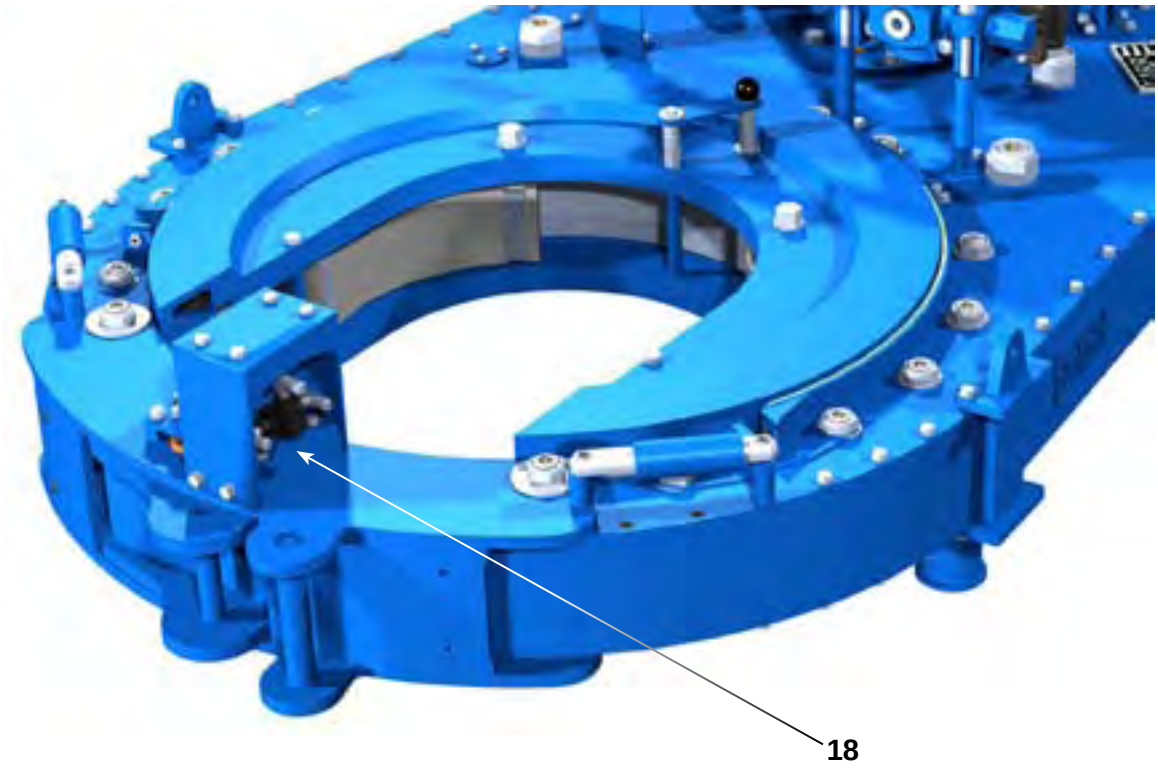


ILLUSTRATION 2.B.5: MAJOR COMPONENT IDENTIFICATION 05

Item	Description	Page
1	Chain Sling Hanger	3.1
2	Control Valve Bank	3.1, 3.2
3	MainTong Assembly	3.1
4	Manual Shift Assembly	3.2
5	Access Panel	3.2
6	Torque Gauge Mounting Plate	3.2
7	Staffa HMB 80 or Rineer GA125 Hydraulic Motor	3.2
8	Motor Mount	3.2
9	Backing Pin Assembly	3.3
10	Cage Plate Assembly	3.3
11	Tong Jaw	3.3
12	Chain Sling Hanger	3.3
13	Brake band	3.3
14	Tong Door Cylinder	3.3
15	RH Door Assembly	3.3
16	Door Latch	3.3
17	LH Door Assembly	3.3
18	Safety Door Hardware (Where equipped)	3.4

C. HYDRAULIC SCHEMATIC & COMPONENT IDENTIFICATION

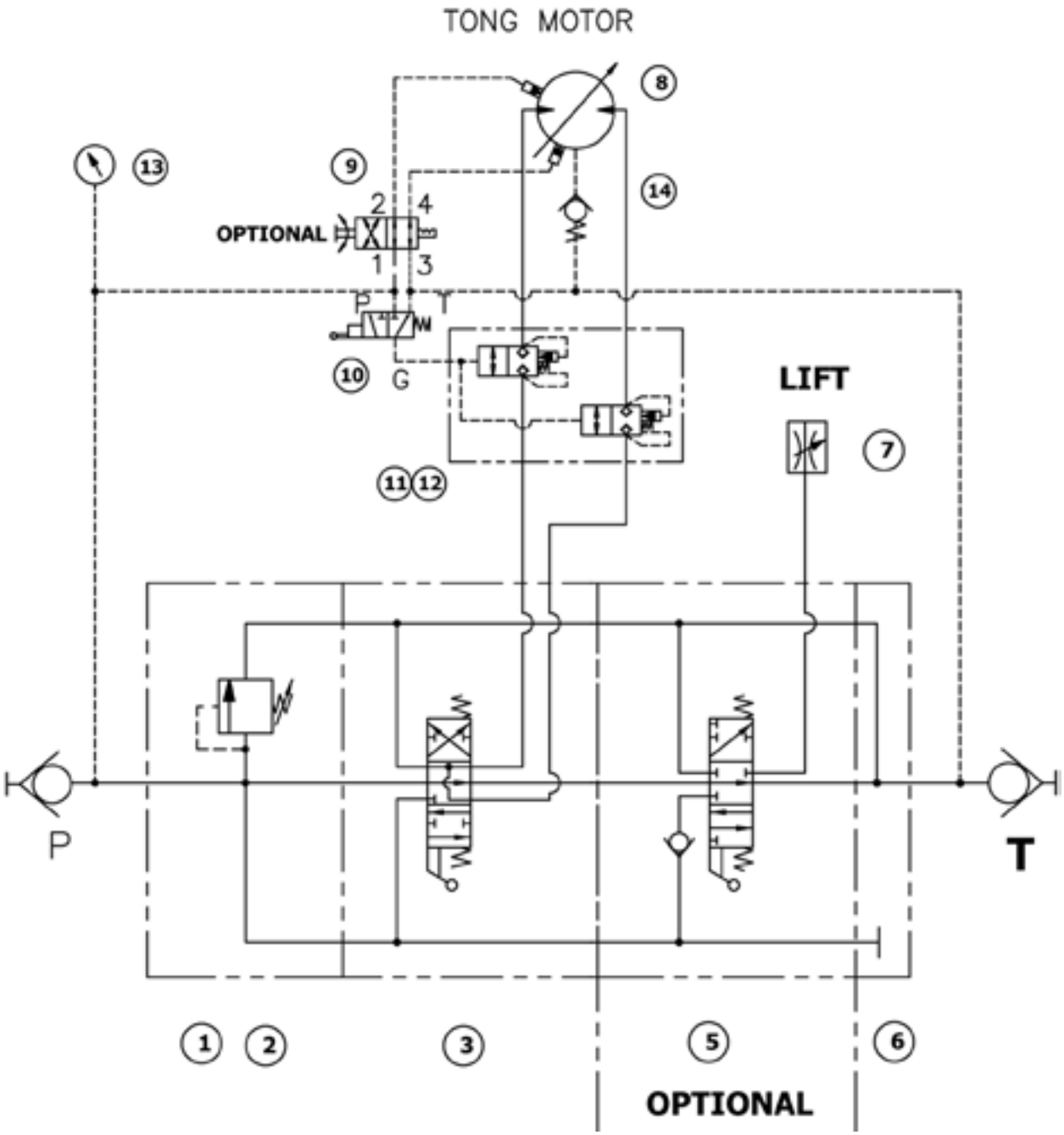


ILLUSTRATION 2.C.1: HYDRAULIC SCHEMATIC

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	DVA35-A880 Inlet Valve	10-9016
2	1	DVA35-MRV-2 Relief Valve	10-0062
3	1	DVA35-MA8 Motor Section Valve	10-9014
5	1	DVA35-SA8 Lift Section Valve	10-9015
6	1	DVA35-TR99 Outlet Valve	10-0086
7	1	1/2" Needle Valve	08-0066

Continued on next page

Hydraulic Component List Continued:			
ITEM	**QTY**	**DESCRIPTION**	**PART NUMBER**
8	1	Staffa HMB 080 Hydraulic Motor	87-0210B
	1	Optional: Rineer GA125 Hydraulic Motor	87-0150
9	1	Motor Speed Valve (Optional)	10-9024
10	1	Safety Door Switch	08-0337M
11	2	Safety Door Valve	08-1625
12	1	Safety Door Valve Block	101-0727
13	1	0 - 3000 Pressure Gauge (not shown)	02-0245
14	1	Check Valve (Optional)	Varies With Application

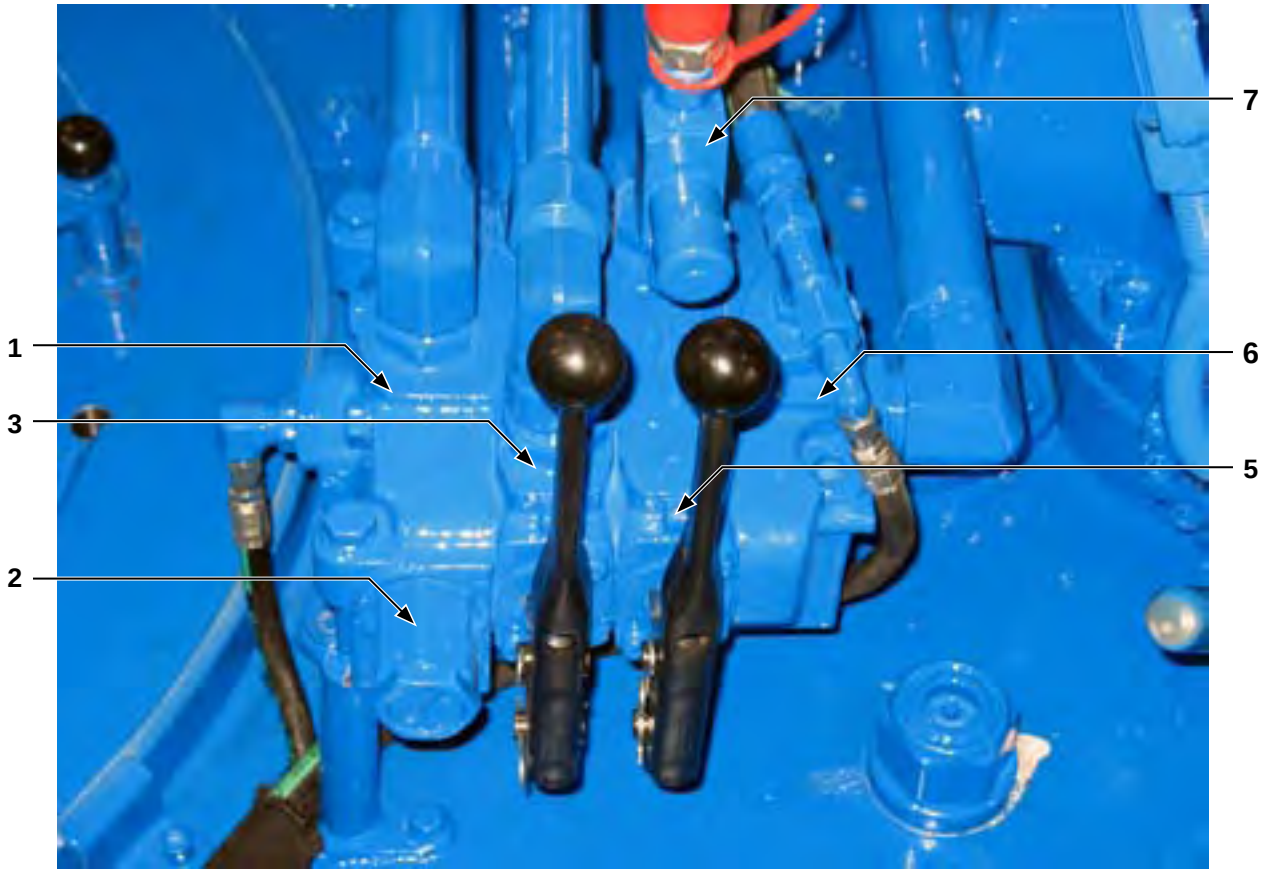


ILLUSTRATION 2.C.2: HYDRAULIC COMPONENT IDENTIFICATION 01

ILLUSTRATION 2.C.3: HYDRAULIC COMPONENT IDENTIFICATION 02

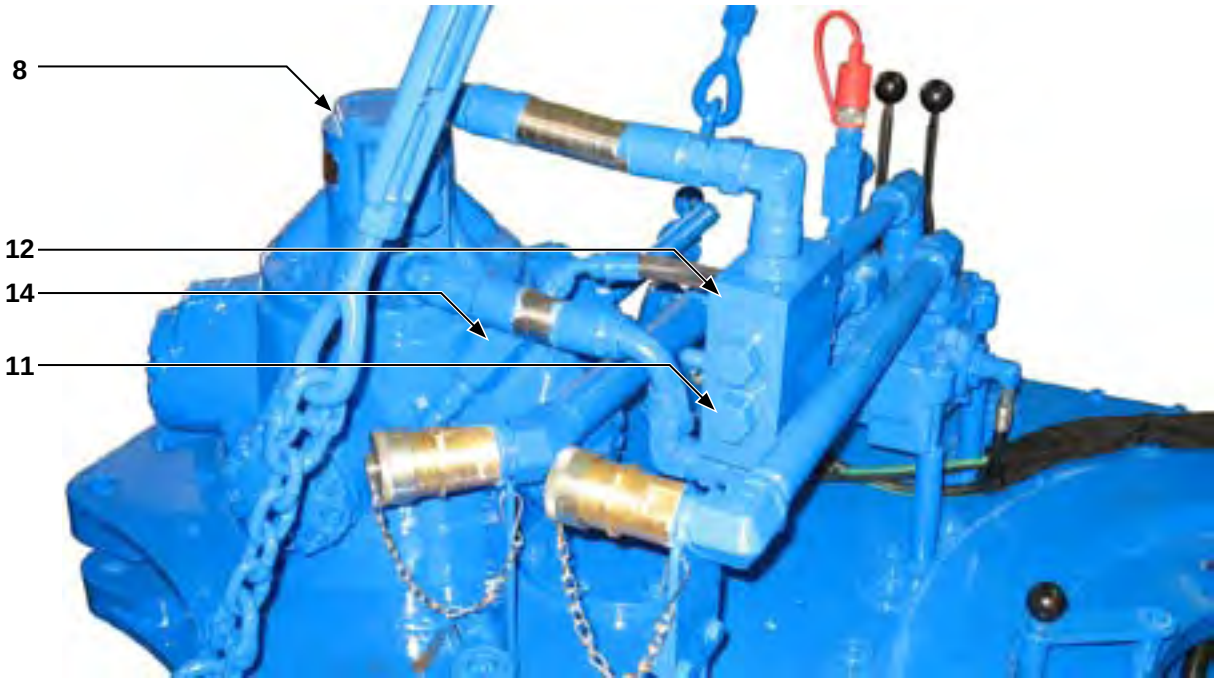


ILLUSTRATION 2.C.4: HYDRAULIC COMPONENT IDENTIFICATION 03

D. HYDRAULIC CONNECTIONS

A pair of hydraulic lines - a 1" supply line and a 1-1/4" return line - connect the tong to the power unit (see illustration below). Ancillary devices (hydraulic motors, hydraulic cylinders, etc.) are connected through the valve block. Perform any hydraulic connection when the power unit is not running, or when the hydraulic pump is disengaged. The possibility of error in inter-changing the high pressure supply hose and the low pressure return hose has been eliminated, because the supply side coupling is smaller than the return side. These hose couplings are self-sealing, and care should be taken to ensure complete engagement to prevent partial closure of the check valve in the coupling. Ensure that the nut (female) side is completely made up onto the male connector - there is a line on the male fitting that indicates complete make-up. Snug the female fitting right up to the line.

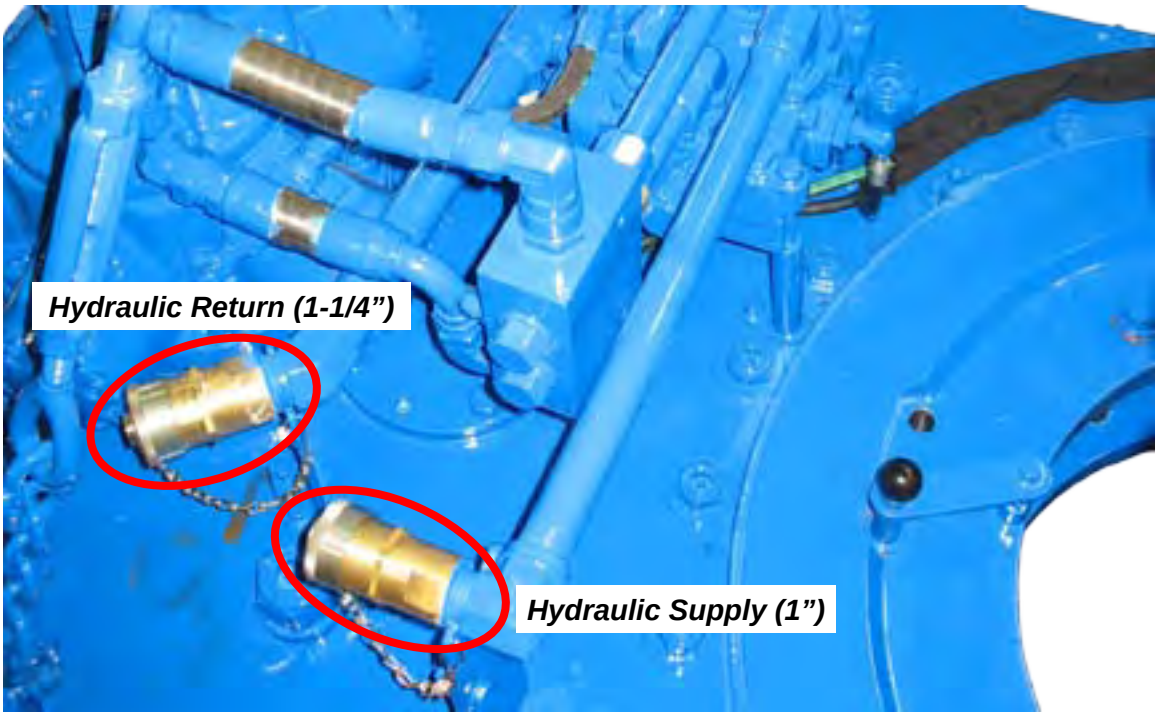


ILLUSTRATION 2.D.1: HYDRAULIC CONNECTIONS 01

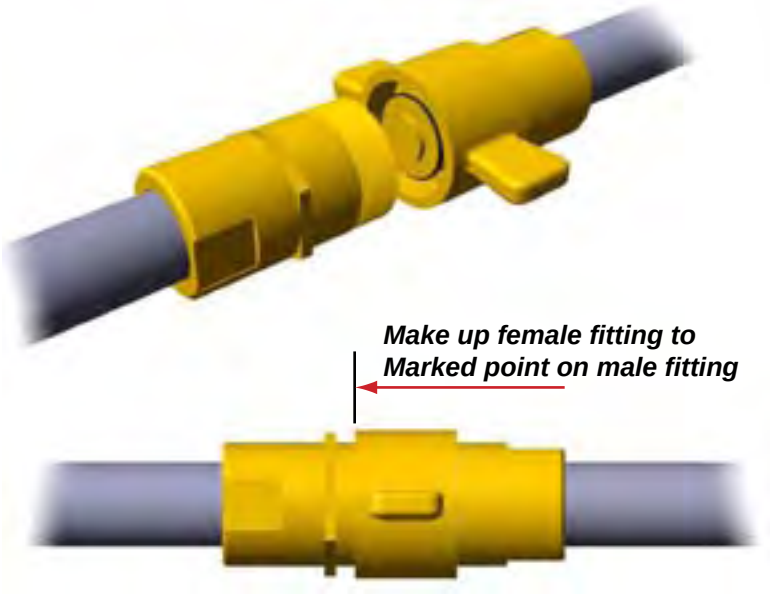


ILLUSTRATION 2.D.2: HYDRAULIC CONNECTIONS 02

E. TONG JAWS

1. Available Jaws

The following table lists all jaw die kits that are available as standard sizes for this model of tong. If your desired size is not listed, Farr can engineer custom jaw sizes - contact sales for further information.

Description	Part Number
7" Jaw Die Kit	1037-JDK-543
7-5/8" Jaw Die Kit	1037-JDK-539
8" Jaw Die Kit	1037-JDK-541
8-1/4" Jaw Die Kit	1037-JDK-542
8-5/8" Jaw Die Kit	1037-JDK-540
9-5/8" Jaw Die Kit	1037-JDK-545
9-7/8" Jaw Die Kit	1037-JDK-547
10" Jaw Die Kit	1037-JDK-546
10-3/4" Jaw Die Kit	1037-JDK-550
11-3/4" Jaw Die Kit	1037-JDK-555
11-7/8" Jaw Die Kit	1037-JDK-557
12-3/4" Jaw Die Kit	1037-JDK-556
13-3/8" Jaw Die Kit	1037-JDK-558
13-5/8" Jaw Die Kit	1037-JDK-560
14" Jaw Die Kit	1037-JDK-561
14-3/8" Jaw Die Kit	1037-JDK-564
15" Jaw Die Kit	1037-JDK-562
16" Jaw Die Kit	1037-JDK-565
17" Jaw Die Kit	1037-JDK-568
18" Jaw Die Kit	1037-JDK-569
18-5/8" Jaw Die Kit	1037-JDK-570
19" Jaw Die Kit	1037-JDK-574
20" Jaw Die Kit	1037-JDK-575
10-3/4" Non-Marking Jaw Die Kit	1037-NMJDK-550
18" Non-Marking Jaw Die Kit	1037-NMJDK-568
Standard 5" Replacement Die	12-1004

2. Jaw Removal & Die Replacement

- *Support tong jaw assembly.*
- *Remove the jaw pivot bolt.*
- *Slide the jaw towards the centre of the rotary assembly to free the jaw from the cage plates.*
- *Remove the flanged retaining bolts to remove the dies - jaw dies may require light tapping with a hammer to free them from their slots.*

Reverse this procedure to install new jaw dies.

Note that if space allows, the entire jaw assembly does not need to be removed to replace the jaw dies (see Illustration 2.E.1).

Jaw Removal & Die Replacement (Continued):

ILLUSTRATION 2.E.1: JAW REMOVAL

Once the jaw has been removed the jaw dies may be replaced by removing the keeper screw above the die, and tap the die from jaw using a hammer. Replace the die, tapping it into place if necessary, and replace the keeper screws.

F. TONG RIG-UP & LEVELING

1. Suspension & Restraint

Suspend the tong from a location as near to the centre of the drill rotary as possible, and from a location high enough on the mast to ensure easy handling. The lower the point from which the tong is suspended, the more effort will be required to move the tong to and from the connection point.

The suspension line may be extended over a pulley and balanced by a counterweight equal to the weight of the tong, or simply tied off in the derrick to form a dead line. When using a dead line arrangement it is necessary to use a FARR® spring hanger assembly (see specification page for recommended spring hanger). This spring hanger compensates for the downward movement of the casing as the thread is made-up, and imparts additional force to the suspension cable:

- *a "single spring" hanger typically applies 420 lbs. (191 kg.) to the suspension line for every inch of thread made up*
- *a "double spring" hanger typically applies 840 lbs. (382 kg.) to the suspension line for every inch of thread made up*

If you do not know which specific spring hanger is in use, check the specification page in this manual for information on the recommended spring hanger for this application. Farr Canada Corp. will not guarantee or specify spring hangers other than what has been supplied by Farr Canada Corp..

Many applications use a lift cylinder for adjusting the height of the tong. Ensure the weight of the lift cylinder is known if it has not been included in the total weight of the tong.

All forces upon the suspension line must be considered when calculating necessary strength of the suspension line. The weight of the tong, the weight of the lift cylinder, the weight of the spring hanger, and the force imparted on the suspension line by the spring hanger must all be added together in order to arrive at the total force supported by the suspension line. Select your suspension line based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the suspension line and selection of the suspension line is the complete responsibility of the customer.

Farr Canada Corp. recommends using dual backup (snub) lines of sufficient strength to withstand the force imparted by the maximum rated torque of the tong in use. Calculate the force on the snub lines by dividing the maximum torque of the tong by the tong's torque arm (expressed in feet). For example, an 50,000 lbs.-ft. tong with a 52 inch (4.333 ft.) torque arm will generate 11,540 lbs. of force against the snub line. Select your snub lines based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the snub line and selection of the snub line is the complete responsibility of the customer.

Suspension & Restraint (Cont'd)

Snub lines must be securely connected to the rear of the tong, and tied off to a suitable anchor. One snub line must be secured to the load cell, which is then secured to the rear of the tong. The side of the tong the load cell connects to is dependant upon whether make-up or break-out activities are underway. To ensure accurate torque measurement, the torque measurement line must be connected perpendicular to the lengthwise axis of the tong, and perpendicular to the hang line (see illustrations 2.F.1 and 2.F.2). Connect the second snub line on the opposite side of the load cell, perpendicular to the lengthwise axis of the tong and perpendicular to the vertical.

MCCOY DRILLING & COMPLETIONS ACCEPTS NO RESPONSIBILITY FOR DESIGNING AND SELECTING AN ADEQUATE SUSPENSION AND RESTRAINT SYSTEM FOR YOUR DRILLING EQUIPMENT

ALL SELECTED FASTENERS, SHACKLES, CLAMPS, ETC. USED FOR CONSTRUCTING THE SUSPENSION AND SNUB LINES MUST BE RATED FOR THE CALCULATED FORCES.

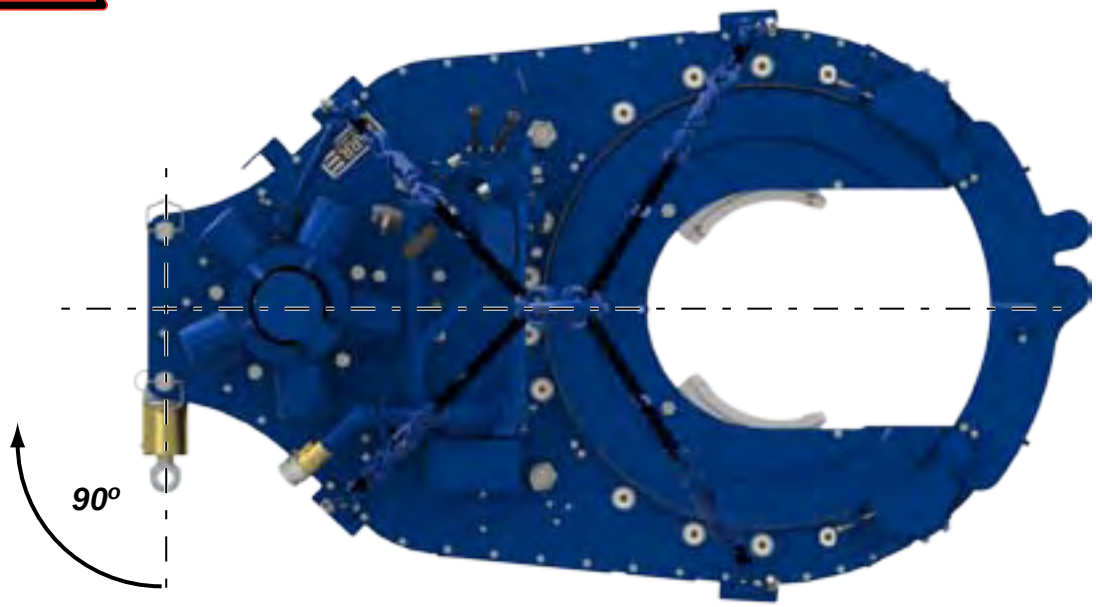


ILLUSTRATION 2.F.1: TONG SUSPENSION RELATIVE TO AXIAL CENTRE

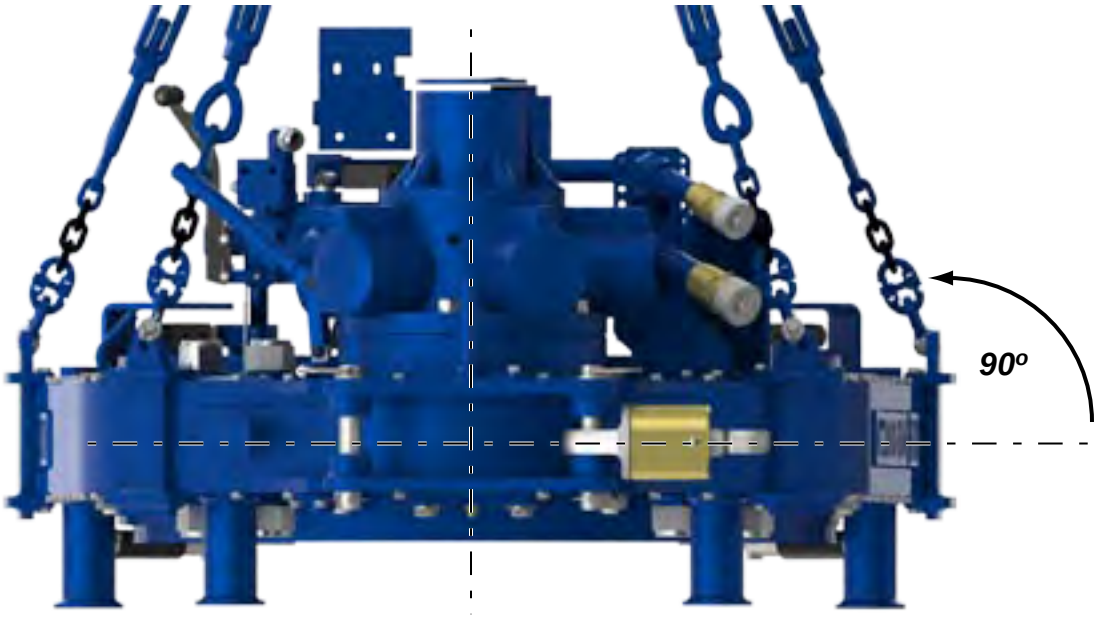


ILLUSTRATION 2.F.2: TONG SUSPENSION RELATIVE TO VERTICAL CENTRE

2. *Tong Leveling*

The tong must be leveled side-to-side and front-to-rear before placing into service. The following guidelines will assist you when leveling your tong.

i. Support the tong by the chain sling. Preset the positions of all four chains by rotating the turnbuckles on each chain hanger until the eye bolts are about half-way engaged in the turnbuckle. The turnbuckles can often be turned by hand; if this is not the case, use an adjustable wrench across the flats on the turnbuckle to turn it. Rotating the turnbuckles in one direction will cause the two eye bolts to extend away from the centre of the turnbuckle, while rotating them in the other direction will cause the eye bolts to retract toward the centre of the turnbuckle.

ii Place a level axially (side to side) across the tong, ensuring that it is parallel with the surface of the tong. Equally rotate the two turnbuckles on one or the other side of the tong until the level indicates the tong is parallel - for instance, if you decide to adjust the left side hangers to adjust the axial leveling, adjust the left side front and rear chains the same amount. If there seems to be a large adjustment to make, split the adjustment between the two sides - make half the adjustment using the two chains on one side, and the remaining adjustment using the two chains on the other side. If all four chains were pre-set, there should not be a large adjustment to make.

iii Place a level lengthwise (front to back) along the tong, ensuring that it is parallel with the surface of the tong. If the tong needs to be leveled front to rear, adjust both chains equally - either both rear chains or both front chains.

The leveling process may have to be repeated in order to optimize the adjustment of the hanger chains and ensure the tong is level.

ILLUSTRATION 2.F.3: LEVELING TONG USING TURNBUCKLES

G. TONG OPERATION

1. Initial Start-up and Break-in Procedure

YOUR EQUIPMENT HAS BEEN THOROUGHLY TESTED AND INSPECTED AT THE FACTORY. HOWEVER, WE ADVISE INSPECTION AND TESTING OF YOUR NEW TONG AFTER TAKING POSSESSION IN ORDER TO ELIMINATE THE POSSIBILITY OF SHIPPING DAMAGE.

McCoy Completions & Drilling recommends that the following pre-operating tests be performed after receipt from the factory or after extended storage, prior to releasing the tong to operations:

- *Perform a complete inspection of all fasteners to ensure none have loosened during transport.*
- *Connect the tong to the power unit, and apply full hydraulic pressure. Inspect and correct any leaks.*
- *Operate the tong at full speed and in high gear for a duration of one-half hour. Hot bearing caps may indicate impending bearing failure.*
- *Switch to low gear and operate for an additional one-half hour at full speed.*
- *Run the backup through several clamp/un-clamp sequences to ensure functionality.*
- *Inspect all components and hydraulic fittings for possible defects following completion of the tests. All FARR® Tongs have been thoroughly tested at the factory prior to shipping, but shipping damage must be identified before running the tong in an operational environment.*
- *Carefully inspect the safety door components, and test to ensure that the safety device on each door is operating correctly before releasing the tong to the operating environment.*

TONG DOOR MUST BE CLOSED AND SECURELY LATCHED BEFORE THE POWER UNIT IS STARTED IN ORDER TO ASSURE THE SAFETY OF OPERATING PERSONNEL

Ensure adequate lube oil and hydraulic oil levels before starting engine. Use start up procedures as recommended by the power unit engine operator's manual. Open the Bypass Valve on the hydraulic system, and inspect all pressure and return line hose connections to ensure correct and secure installation.

IMPROPERLY SECURED HYDRAULIC CONNECTIONS WILL INTERRUPT HYDRAULIC FLUID FLOW, AND COULD RESULT IN THE FOLLOWING FAILURES:

- *A restriction in the pressure supply hose will result in high pressure within the power unit hydraulic system, which will activate the hydraulic governor and increase the engine speed to as high as maximum RPM.*
- *A restriction in the return line will result in high pressure within the power unit and the tong hydraulic system, causing engine speeds as high as maximum RPM, and possible failure of the motor seal.*

Following inspection of the hoses, start the engine and allow it to idle until warm. Allow hydraulic fluid to circulate for approximately 10 minutes, then slowly close the Bypass Valve to allow hydraulic fluid to circulate through the hoses and to the tong (circulating pressure should not exceed 200 psi). Place the tong gear shifter in low gear and rotate the tong slowly forward and then reverse with the throttle valve control lever. Once this has been done and the proper size jaws have been installed, the tong is then ready to run pipe.

2. VALVE OPERATION

4-way proportional valves control operation of hydraulic devices on the tong assembly such as hydraulic motors and cylinders. When any one valve is "centered" or in the detent position, there is no hydraulic output from the valve. When the valve is pushed forward there is an effect, and when the valve is pulled back, there is an opposite effect. These valves feature proportional control, which means that further extension of the valve handle (thereby further opening the valve orifice) results in proportionally higher hydraulic output to the controlled device.

The following illustrations demonstrate the type and effect of the hydraulic valves with which this tong is may be equipped.

TONG MOTOR

This is a proportional valve. Pushing the valve handle forward will cause the tong motor to rotate in a clockwise direction (as seen from the top of the tong). This is the desired direction of rotation for making up a joint. Pulling the valve handle in the opposite direction results in counter-clockwise rotation, which is the desired direction of rotation for breaking out a joint.

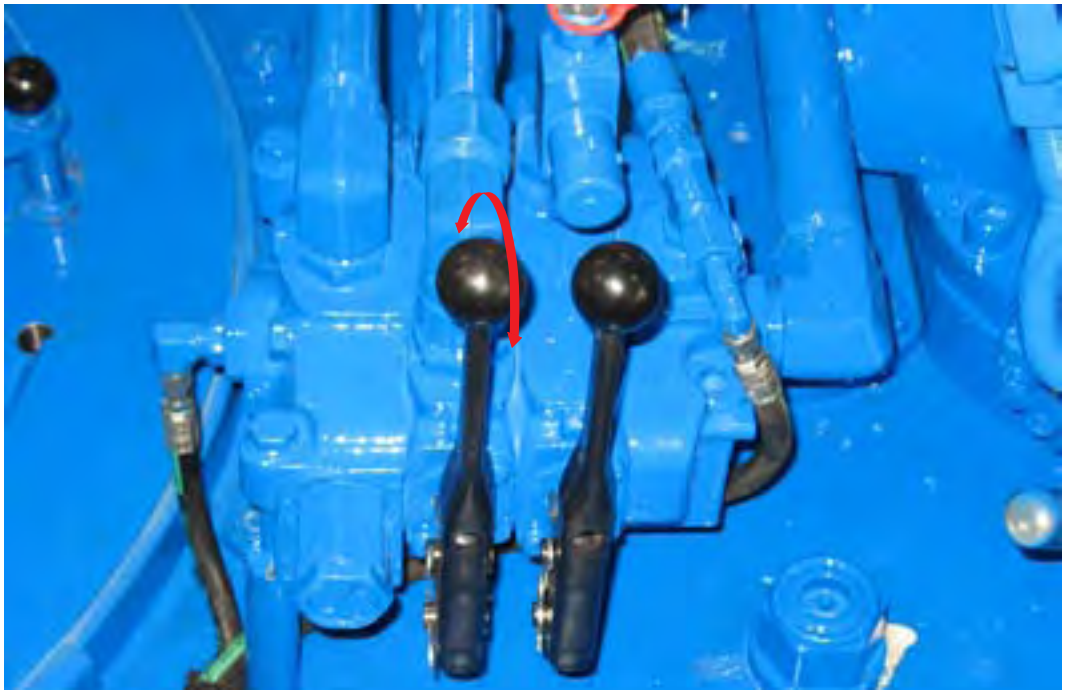


ILLUSTRATION 2.G.1: MOTOR CONTROL VALVE

LIFT CYLINDER

This is a proportional valve. Pushing the valve handle forward will cause the lift cylinder to lift the tong vertically. Pulling the valve handle in the opposite direction will cause the lift cylinder to lower the tong.

ILLUSTRATION 2.G.2: LIFT CYLINDER CONTROL VALVE

3. SHIFTING GEARS

The shifting shaft has three "detent" positions identifying the low speed/high torque position, the "neutral" or free-spinning position, and the high speed/low torque position. The detent strength may be adjusted by releasing the locknut on the detent tube and increasing or relaxing pressure on the detent spring. Ensure the locknut is tightened once the desired detent pressure has been set.

To shift to the high-speed gear, move the shifting handle downward from neutral position. To shift to the low-speed gear, move the shifting handle up through the neutral detent to its highest position. Note that the high clutch gear or the low clutch gear may not be exactly aligned when shifting, so the operator may need to "bump" the motor control handle slightly to turn the main clutch gear shaft and shifting collar into alignment. This is most effective when applying a small amount of pressure on the gear shift lever in the direction you want to shift the tong, ensuring the shifting collar will "catch" when the main clutch gear aligns with either the high or low clutch gear (see Illustration 2.G.3).

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

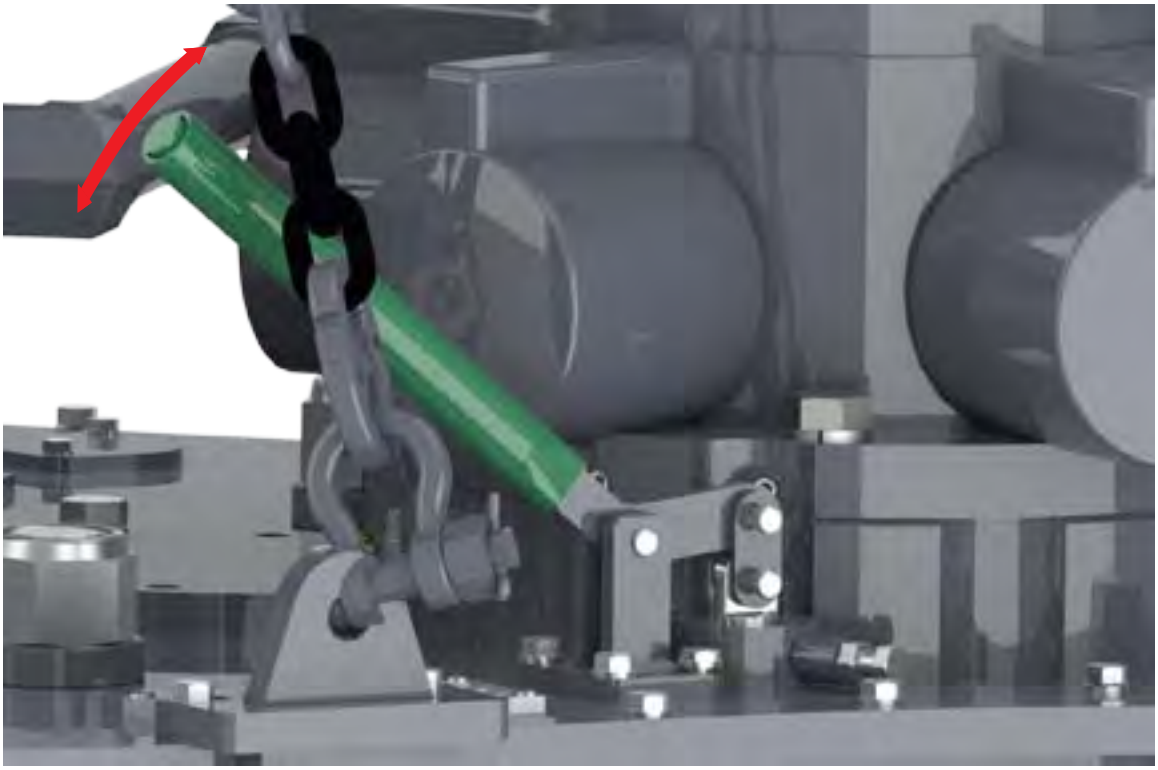


ILLUSTRATION 2.G.3: SHIFTING GEARS

4. GENERAL COMMENTS

a) *Position rotary gear in contact with both idler gears when breaking out joints or collars where high torques are required.*

b) *When making-up integral (shouldered) joints, it is essential to make up the last turn of the threads in low gear. This reduces the tendency of an instant stop or a sudden increase in torque, which induces extremely high stresses on the gear train.*

c) *DO NOT employ the "snap break" method of breaking-out joints when pulling a string. By definition, the "snap break" method is a procedure used by some operators to break out connections, accomplished by leaving slack in the "jaw-pipe" engagement, and then quickly pulling the throttle valve control lever allowing the tong to snap into its loaded or high torque condition. Although this method is very effective in breaking out joints, the extremely high stress placed on the gear train frequently causes gear breakage.*

THE "SNAP-BREAK" METHOD IS HAZARDOUS TO RIG PERSONNEL AND EQUIPMENT

H. MAKING AND BREAKING CONNECTIONS

THESE OPERATING PROCEDURES ASSUME THE USER HAS PROPERLY SET UP AND PREPARED THE EQUIPMENT FOR OPERATION AS PER SECTIONS 2D, 2E, AND 2F OF THIS MANUAL.

Set up and prepare your equipment for operation as per Section 2 of this manual Refer to the following sections:

- *2.D - Hydraulic Connections*
- *2.E - Tong Jaw Installation*
- *2.F.1 - Tong Rig-up and Leveling (Suspension)*
- *2.F.2 - Tong Rig-up and Leveling (Leveling)*

Your tong and backup assembly should be properly suspended, connected to a hydraulic power source, and ready to make or break connections at this point.

1. Making A Connection

a) *Ensure hydraulic power supply to the tong is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong from any other point.*

ILLUSTRATION 2.H.1: MASTER LIFTING LINK

THE MASTER LINK MUST BE USED TO SUSPEND THE TONG ASSEMBLY

b) *Ensure the backing pin is in the "makeup" position. From the front of the tong, the backing pin correctly configured for makeup will be in the 10 o'clock position (see Illustration 2.H.2 next page). If it is not, simply lift up and place in the correct position. The cage plate opening must be aligned with the door opening when setting the backing pin position.*

Making A Connection (Continued)

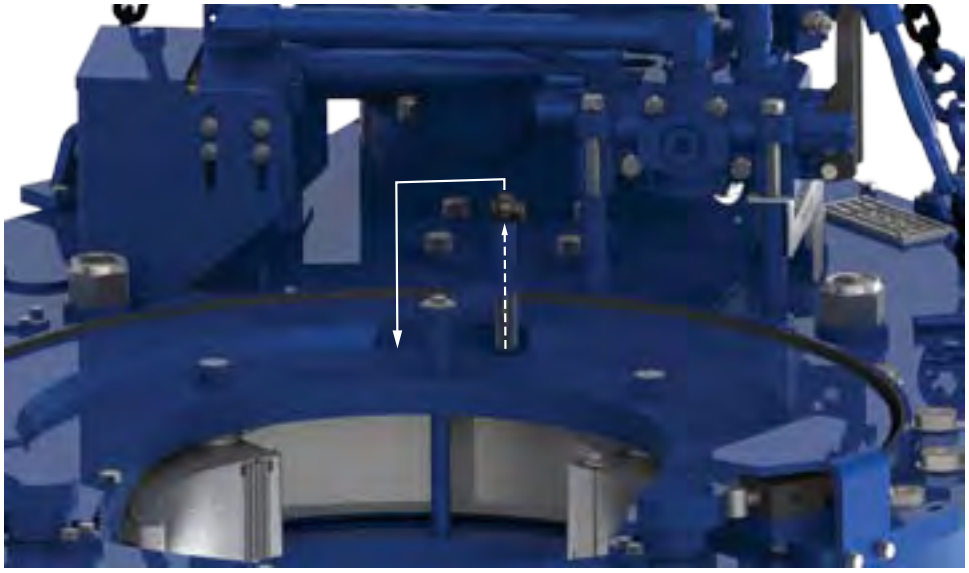


ILLUSTRATION 2.H.2: SETTING BACKING PIN TO "MAKE-UP" POSITION

c) *Ensure the load cell and snub line(s) are properly configured for making up connections. A "snub line" is a length of wire rope that connects the rear of the tong body to a sturdy anchor on the drill floor (see Section 2.F.1). The snub line prevents the tong body from spinning in the opposite direction of the cage plate when torque begins to build in the joint. Farr Canada Corp. recommends using two snub lines when running the equipment to eliminate uncontrolled movement in either rotational direction. The snub line(s) must be rated for the applied torque plus whatever safety margins stated by your own operating policies. The snub line connection point on the drill floor must be sturdy enough to absorb all applied forces when making up the joints. When making up joints the load cell must be connected to the driller's side of the tong, which is the left side of the tong as seen from the rear. For accurate torque measurement the snub line between the tong body and the anchor must be perpendicular to the vertical, and perpendicular to the centre-line of the tong.*

d) *Actuate the lift cylinder control valve to lift the assembly from the drill floor. Pushing the valve toward the center of the tong will retract the lift cylinder to lift the assembly (see Illustration 2.H.3 below). Note that rig personnel are required to stabilize the tong and backup as it is being lifted so it does not swing and collide with other rig equipment.*

RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR

ILLUSTRATION 2.H.3: LIFT CYLINDER CONTROL - RAISE

Making A Connection (Continued)

e) *Grasp the tong door latch and pull to open the door on the left side (as seen from the front of the tong). After the latch-side door is open grasp the handle on the second door and swing open. Since your equipment is equipped with safety doors, opening the door will inhibit rotation of the cage plate.*

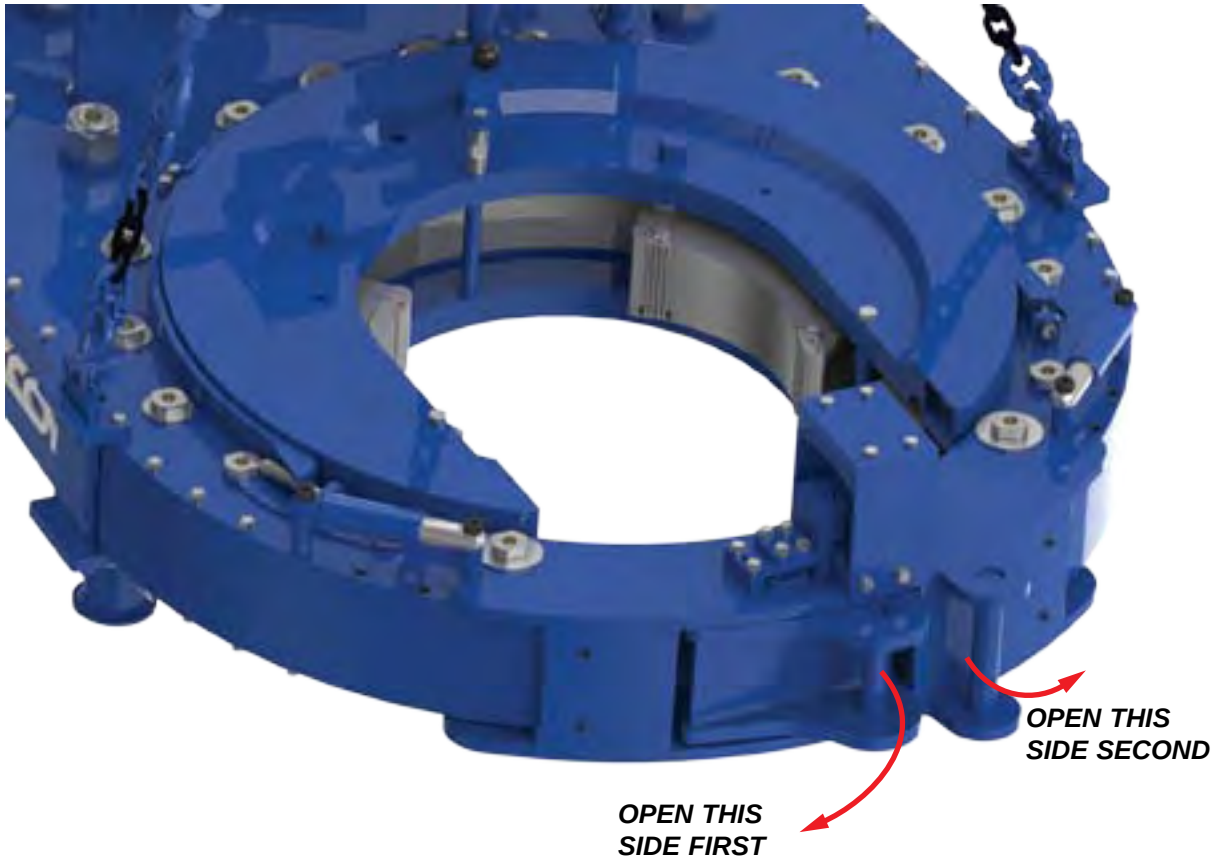


ILLUSTRATION 2.H.4: OPENING TONG DOORS

f) *Manually engage the threads of the tubing connection being made up. Ensure threads are not cross-threaded.*

g) *Move the tong on to the tubing joint. Use the lift cylinder to ensure the tong jaws are at the correct location above the connection joint.*

h) *Firmly close the tong door on the right side (as seen from the front of the tong), followed by the latched door (on the left side as seen from the front). Tug firmly on the door handle on the right side (as seen from the front) to ensure the latch is firmly engaged.*

i) *Ensure tubing is roughly centered within the tong jaws - rig personnel are required to stabilize the tong above the connection until the jaws have been cammed on to the pipe or casing.*

j) *Begin rotation with the tong in high gear (high speed/low torque). See Section G.3 to properly set the tong to high gear. Do not shift gears while the tong is rotating.*

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

Making A Connection (Continued)

k) Push the motor control valve toward the tong to rotate the cage plate in the make-up direction.

ILLUSTRATION 2.H.5: MOTOR CONTROL - MAKE-UP

l) When the tong jaws cam on to the tubing push the rotation control handle all the way in to thread the connection together at high speed. As the joint becomes fully made up the increasing torque demand will stall the motor, and displayed torque will increase.

m) Stop rotation and shift to low gear (low speed/high torque). See Section 2.G.3 for instructions for shifting to low gear. This will enable the tong to produce adequate torque for making up the joint to specification.

n) Push the rotation control handle all the way in to complete the connection at low speed/high torque. Observe the torque gauge - when the specified make-up torque is reached stop rotation. Reverse the rotation control valve to release the tong jaws from the tubing (see Illustration 2.H.6).

ILLUSTRATION 2.H.6: MOTOR CONTROL - RELEASING JAWS

Making A Connection (Continued)

o) *When tong jaws are free, align the opening in the rotary gear with the mouth of the tong, and open the tong doors to free the tong from the drill string. Note that rig personnel may be required to stabilize the tong as it completely releases from the drill string. Guide the tong away from the string and use the lift cylinder control to lower it to the drill floor if desired.*

ILLUSTRATION 2.H.7: LIFT CYLINDER CONTROL - LOWER

p) *Repeat steps "f" through "o" until the desired number of connections are made up.*

2. Breaking A Connection

YOUR TONG SHOULD BE PROPERLY SUSPENDED, CONNECTED TO A HYDRAULIC POWER SOURCE, AND READY TO BREAK CONNECTIONS.

a) *Ensure hydraulic power supply to the tong and backup is energized. The master link on the rigid sling must be used to suspend the tong. Do not suspend the tong from any other point. See Illustration 2.H.1.*

b) *Set the backing pin for "breakout" operation. Lift up on the backing pin and rotate it to the "breakout" position, which is 2 o'clock as seen from the front of the tong. The opening in the rotary gear must be aligned with the tong door opening in order to properly set the backing pin (see Illustration 2.H.8).*

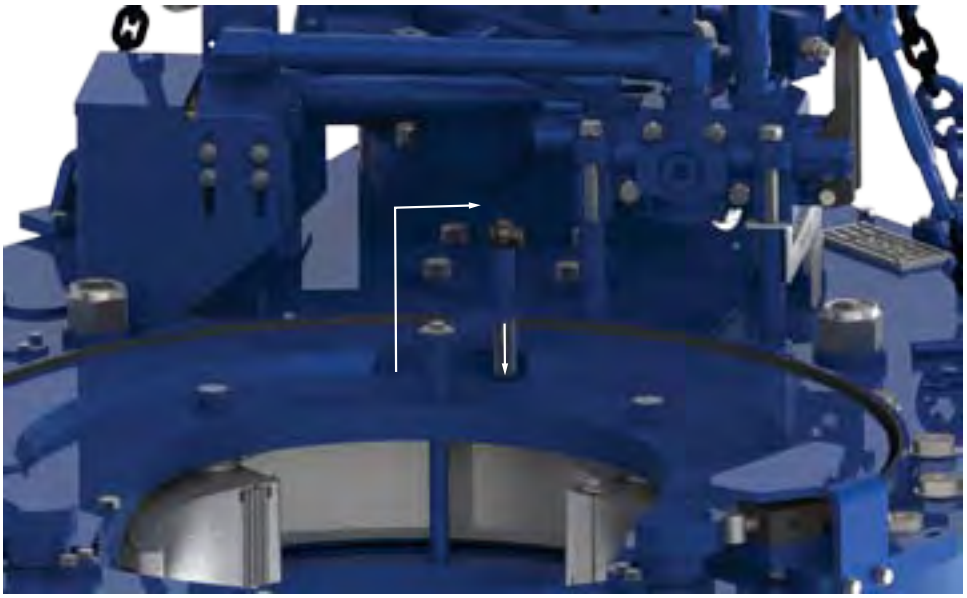


ILLUSTRATION 2.H.8: SETTING BACKING PIN TO "BREAK-OUT" POSITION

c) *Ensure the load cell and snub line are configured for break-out operation. The load cell must be transferred to the off-driller's side (the right hand side as seen from the rear of the tong), and the snub line must be transferred to the driller's side to perform break-out operations.*

d) *Open the tong doors (see Illustration 2.H.4).*

e) *Actuate the lift cylinder control valve to lift the assembly from the drill floor if necessary. Pushing the valve toward the center of the tong will retract the lift cylinder to lift the assembly (see illustration 2.H.3). Note that rig personnel are required to stabilize the tong and backup as it is being lifted so it does not swing and collide with other rig equipment.*

RIG PERSONNEL MUST STABILIZE THE TONG AS IT IS LIFTED FROM THE DRILL FLOOR

f) *Move the tong on to the tubing joint. Use the lift cylinder to ensure the tong jaws are at the correct location above the connection joint.*

g) *Firmly close the tong door against the latch post.*

h) *Ensure tubing is roughly centered within the tong jaws - rig personnel are required to stabilize the tong above the connection until the jaws have been cammed on to the pipe or casing.*

i) *Breakout torque is only available when tong is in low gear. See Section 2.G.3 for instructions on shifting your tong to low gear. Do not shift gears while the tong is rotating.*

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

Breaking A Connection (Continued)

j) Pull the motor control valve toward the operator to rotate the cage plate in the break-out direction.

ILLUSTRATION 2.H.9: ROTATION CONTROL - BREAK-OUT

l) When the tong jaws cam on to the tubing pull the rotation control handle all the way out to break the connection.

m) When the connection breaks stop rotation and shift to high gear (see Section 2.G.3 to shift to high gear). This will enable the tong to completely un-thread the connection at high speed.

n) Pull the rotation control handle all the way out to completely un-thread the connection. Reverse the rotation control handle (push toward tong) to release the tong jaws from the tubing (see Illustration 2.H.10).

ILLUSTRATION 2.H.10: RELEASING TONG JAWS FOLLOWING BREAK-OUT & UN-THREADING

Breaking A Connection (Continued)

o) When the tong jaws disengage align the opening in the rotary gear with the mouth of the tong, and open the tong door to free the tong from the drill string. Unlatch and open the tong door to free the assembly from the tubing. Note that rig personnel may be required to stabilize the equipment as it completely releases from the tubing. Guide the assembly away from the string and use the lift cylinder control to lower it to the drill floor if desired.

ILLUSTRATION 2.H.11: LOWERING TONG USING LIFT CYLINDER CONTROL

p) Use your rig's standard pipe handling procedures to remove and rack the freed tubing stand.

q) Repeat steps "e" through "p" as many times as necessary to break out and un-thread the desired number of connections.

H. EXTREME COLD WEATHER OPERATION PROCEDURES

1) Consult the power unit engine operator's manual for all cold weather operating procedures and precautions.

2) Select gear and bearing lubricants that are compatible with expected climatic conditions.

3) Select hydraulic fluid that is compatible with expected climatic conditions.

4) Allow hydraulic fluid to circulate for approximately 20 minutes after starting the power unit, prior to activating the bypass valve to allow fluid to circulate to tong. If the power unit is equipped with an oil temperature gauge, ensure that the fluid has reached operating temperature as specified by hydraulic fluid data sheet.

5) Allow for adequate drying of moisture (prior to lubricating) when cleaning tong parts in cold weather.

McCoy Drilling & Completions recognizes that minor on-site repairs and modifications are required to maintain peak operating condition of your equipment, or to match your equipment with the operating environment. Examples of minor repairs are:

- *replacement of damaged hydraulic hoses and fittings.*
- *replacement of malfunctioning pressure gauges and valves.*
- *replacement of door cylinders*
- *replacement of fasteners*

Any replaced component must be an identical component supplied by McCoy Drilling & Completions. Replaced fasteners must be Grade 8 or equivalent, or whatever fastener is specified by McCoy Drilling & Completions.

A. GENERAL MAINTENANCE SAFETY PRACTICES

The practices identified here are intended as a guideline. All personnel are responsible for performing their tasks in a manner that ensures worker, equipment, and environmental safety, and may require taking additional steps that are not identified in this section.

Equipment maintenance shall be performed only by designated qualified maintenance personnel. Wear approved eye wear and footwear, and follow all of your company's safety guidelines Do not begin a maintenance task without the proper tools or materials on hand, or the proper drawings and documentation necessary.

Schedule planned maintenance with operators to avoid conflicts, unnecessary downtime, and the danger of accidental equipment activation. Notify operations when maintenance procedures are complete and equipment functionality is restored.

Isolate the location of the maintenance under way to prevent unaware personnel from inadvertently exposing themselves to a hazard. Use tape, rope, or signage to clearly indicate "off-limits" area.

Replacement of large, heavy individual parts and/or heavy structural components must be performed using an approved lifting device of sufficient lifting capacity. Use care when attaching the lifting device, and safeguard area to avoid endangering personnel or equipment.

All spare parts must meet or exceed OEM specifications in order to maintain equipment integrity, especially protective equipment

McCoy Drilling & Completions recommends that disconnection of hydraulic connectors be performed with the power unit off and the hydraulic circuit depressurized.

Your equipment uses materials that may be harmful to the environment if improperly disposed of (hydraulic fluid, grease, etc.). Dispose of all materials according to your company's proscribed environmental protection regulations.

B. CLEANING

Clean tong thoroughly cleaned with a good petroleum-based cleaning agent after each job, prior to storage. Farr recommends that the motor and valve assembly be periodically removed, along with the top tong plate, so that guides, rollers and gears can be properly cleaned. Ensure that cleaning solvents and chemicals are captured to prevent environmental contamination, and dispose of all materials according to your company's proscribed environmental protection regulations.

C. PREVENTIVE MAINTENANCE PRACTICES

Regular maintenance programs are necessary, and must be established to assure safe, dependable operation of your Hydraulic Tubular Connection System and to avoid costly breakdown maintenance. The following maintenance procedures provides information required to properly maintain your equipment. Your equipment may require more, or less maintenance depending upon the frequency of use and the field conditions under which your equipment operates. These maintenance procedures are designed for equipment operating at 10°C to 35°C ambient temperature for 10 hours per day. McCoy Drilling & Completions recommends that the inspection and maintenance procedures in this section be performed as recommended in the maintenance checklists (see Appendices), or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

Purchased components included with your hydraulic tubular connection equipment (for example: motors, valves, etc.) may specify maintenance tasks and intervals over and above what McCoy Drilling & Completions recommends as part of their recommended procedures. Users of this equipment may choose to perform or ignore these additional tasks at their discretion.

Premature fouling of particulate filters within your prime mover or ancillary hydraulic power unit requires immediate hydraulic fluid laboratory analysis to prevent premature wear of hydraulic system due to high levels of wear metals in the fluid.

McCoy Drilling & Completions recommends tracking all maintenance activity including the lubrication schedule. This may be a simple as keeping a paper log, or using a software-based maintenance tracking utility. A maintenance log is a valuable tool that can be used for easily retrieving maintenance history or identifying trends that require correction.

D. LUBRICATION

Use a quality multipurpose bearing lubricant that will remain within its viscosity range at expected operating temperatures. In addition, Farr recommends the following lubrication procedure at the completion of each job prior to storage.

1. Cage Plate Cam Followers

The cage plate cam followers are sealed units, and do not require lubrication. However, the cage plate and rotary gear grooves in which the cam followers ride should be lightly greased. When the cage plate is rotated as a unit, the cam followers are exposed, and can be greased. Continue rotating the cage plate assembly until all cam followers, top and bottom, are greased (see first illustration below).

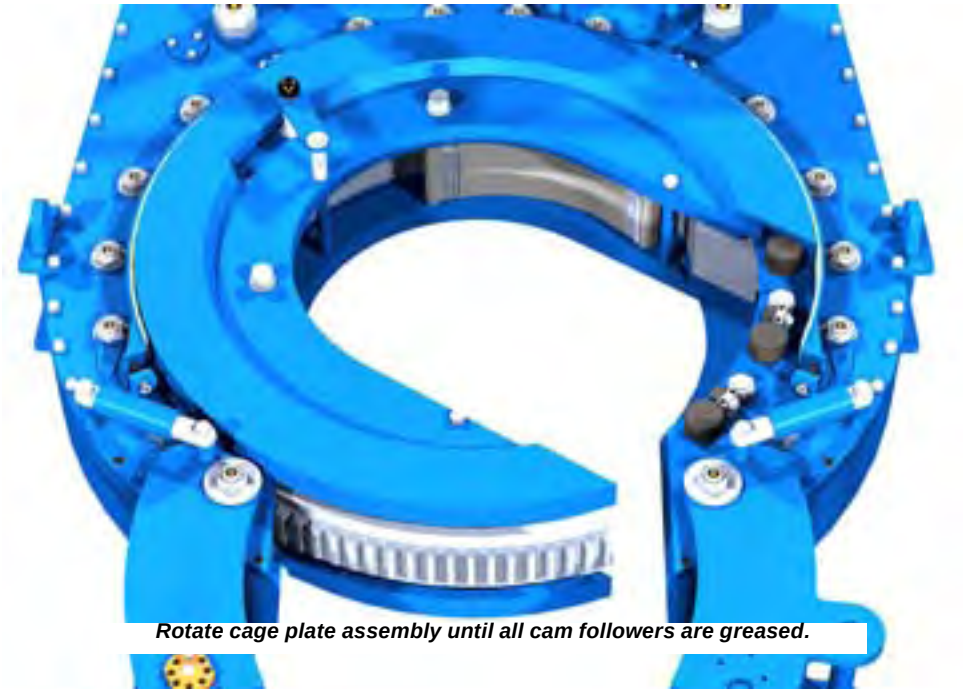


ILLUSTRATION 3.D.1: CAGE PLATE CAM FOLLOWER LUBRICATION

Rotate the rotary gear into the mouth opening as illustrated below. Apply grease to the top and bottom cage plate grooves. Continue to rotate the rotary gear and lubricate the grooves until the gear is well lubricated.

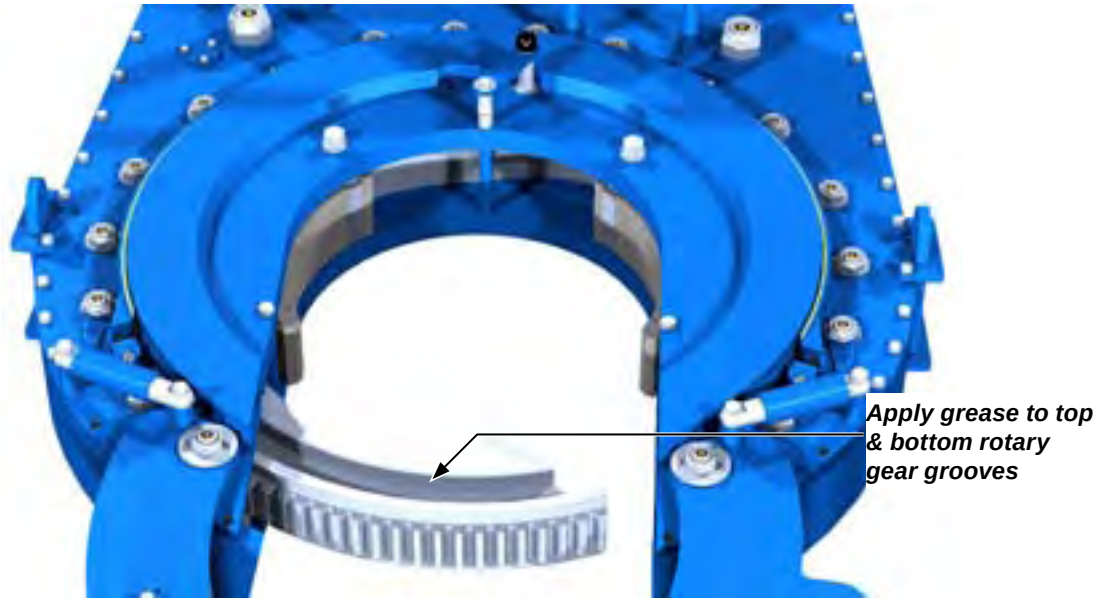


ILLUSTRATION 3.D.2: ROTARY GEAR LUBRICATION

2. ***Support Roller Bearings***

Lubricate support roller bearings through the grease fittings in the top ends of the support roller shafts (16 locations total).

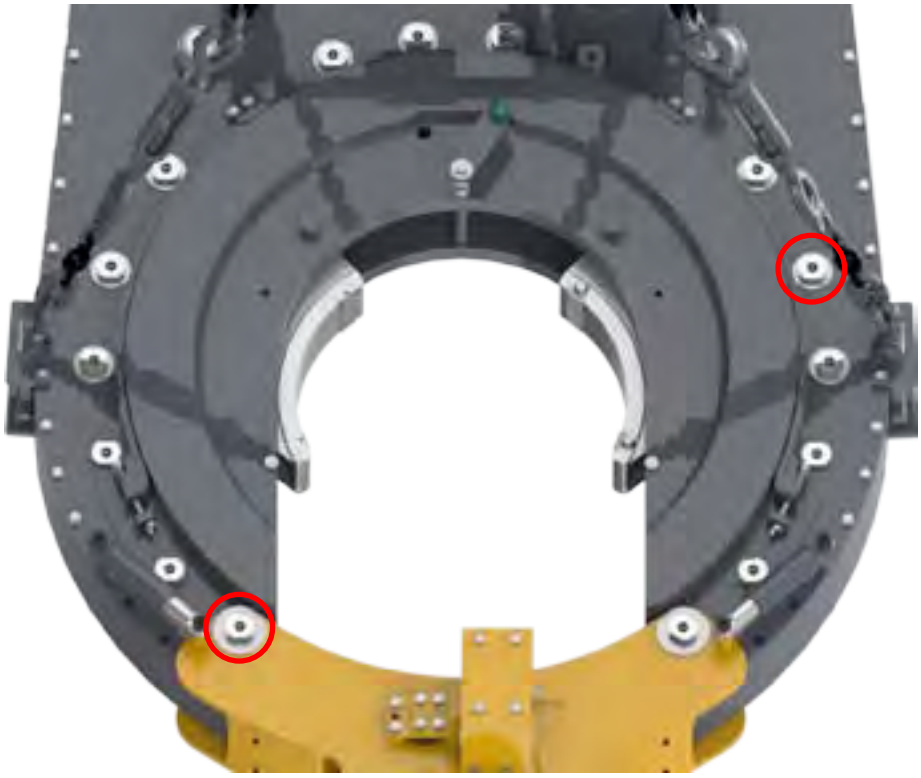


ILLUSTRATION 3.D.3: SUPPORT ROLLER LUBRICATION

3. ***Rotary Idler Bearings***

Apply grease to these bearings through the grease fittings in the ends of the rotary idler shafts (2 locations total), located on the top face of the tong.

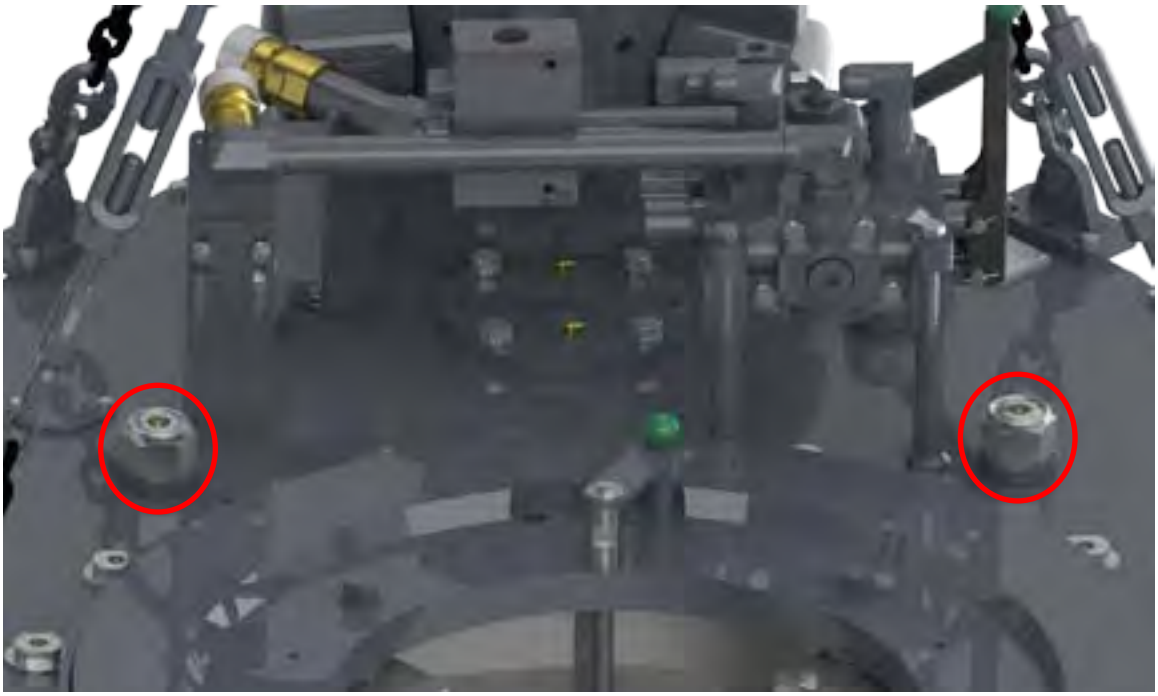


ILLUSTRATION 3.D.4: ROTARY IDLER LUBRICATION

4. **Pinion Idler Bearings**

Apply grease to these bearings through the grease fittings in the ends of the idler half shafts, located on the bottom face of the tong (2 locations total).

ILLUSTRATION 3.D.5: PINION IDLER LUBRICATION

5. **Pinion Bearings**

Apply grease to these bearings through the grease fittings in the pinion bearing caps, which are located on the top face of the tong under the hydraulics and on the bottom face of the tong between the pinion idlers (four locations total).

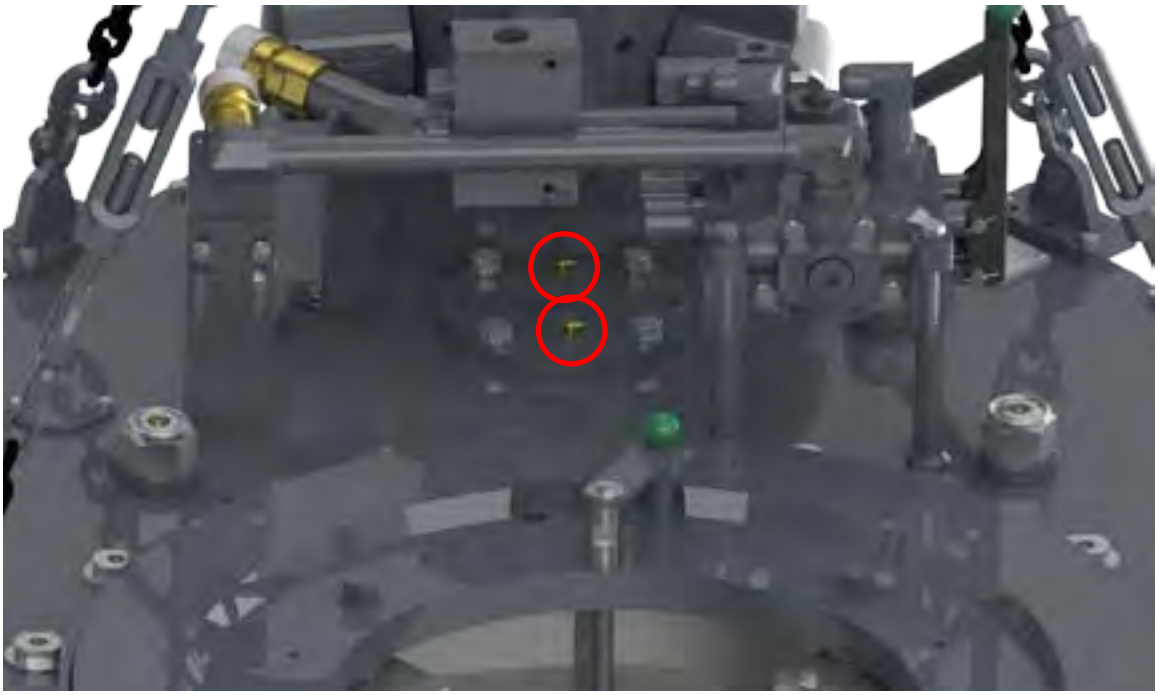


ILLUSTRATION 3.D.6: PINION LUBRICATION

6. ***Clutch Shaft***

Apply grease to these bearings through the grease fittings in the clutch bearing cap which is located at the bottom face of the tong. Do not neglect to apply grease to the middle fitting, which is inset in the bearing cap.

ILLUSTRATION 3.D.7: CLUTCH SHAFT LUBRICATION

7. ***Shifting Shaft***

Apply grease to the shifting shaft and shifting shaft bushings, which may be accessed through the cover plate on the side of the tong.

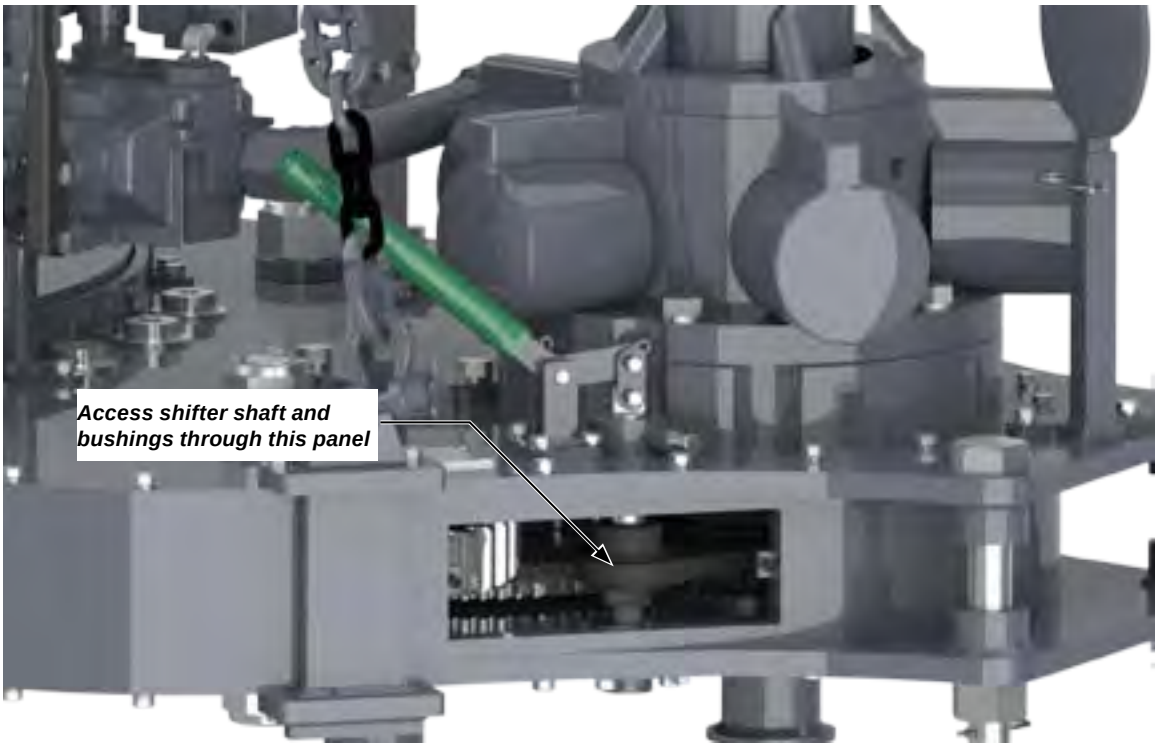


ILLUSTRATION 3.D.8: SHIFTER COMPONENT LUBRICATION ACCESS

8. Jaw Rollers

Apply grease to the jaw rollers through the grease fitting at the end of the jaw roller pin.

ILLUSTRATION 3.D.9: JAW ROLLER LUBRICATION

9. Door Spring Cylinder

Periodically disassemble the door spring cylinders and coat the spring and cylinder with a general purpose lubricating oil.

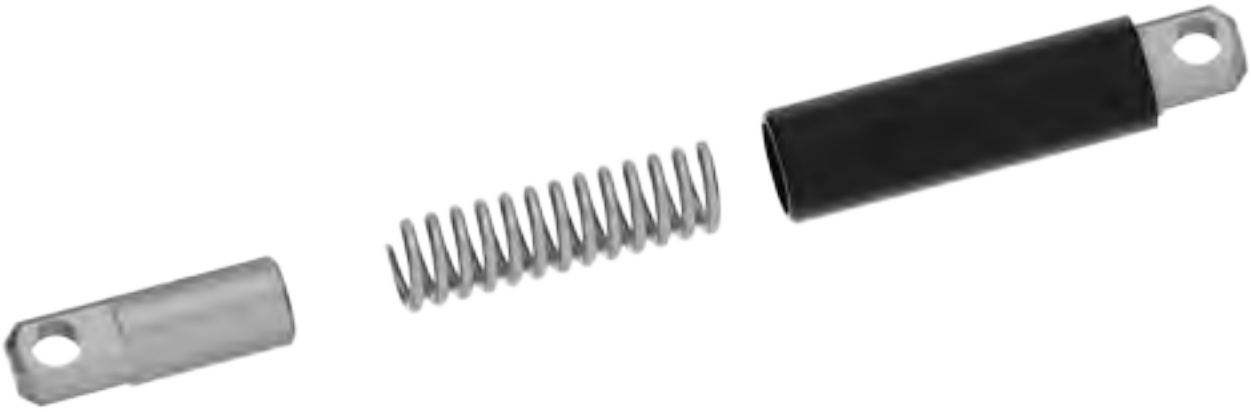


ILLUSTRATION 3.D.10: DOOR SPRING CYLINDER LUBRICATION

McCoy Drilling & Completions recommends that a coating of grease be applied to the cam surface of the rotary gear prior to jaw installation.

E. ADJUSTMENTS

1. Brake band Adjustments:

The brake bands must be periodically adjusted to continue to provide smooth and efficient jaw cam action. If the cage plate turns with the rotary gear, the jaws will not cam properly and, therefore, will not bite on the tubing or casing. Tightening the brake band against the cage plates will increase frictional resistance, allowing jaws to cam properly and grip the casing. Adjust the brake band using the adjustment nut and bolt set as shown in the illustration below. Do not over-tighten, as this causes excessive wear to the brake bands. Ensure top and bottom brake bands are adjusted at the same time.

TOP AND BOTTOM BRAKE BANDS MUST BE ADJUSTED SIMULTANEOUSLY

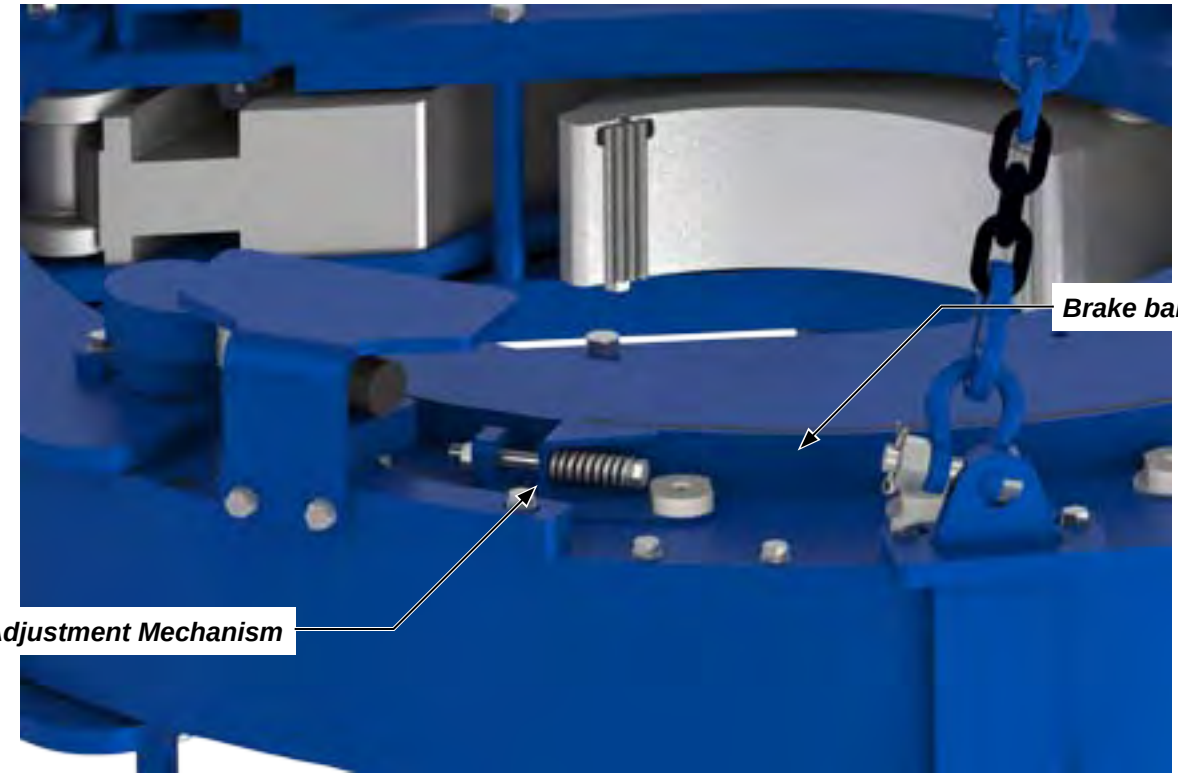


ILLUSTRATION 3.E.1: BRAKE BAND ADJUSTMENT

2. Door Latch Adjustment:

Normal operation of the tong may cause wear of the door latch, which will cause the door to develop a loose fit at the latch. Two latch cam plates are located on the right-hand door assembly, one on the top of the weldment and one on the bottom (see Illustration 3.E.2 next page). The cam plates have eight positioning holes located on a 360 degree bolt circle. The latch cam shaft extends down through the door and is secured at the top by a 3/8" hex head bolt. To make adjustments in door alignment, remove the 3/8" bolt and turn the cams with a wrench. When the door has been adequately aligned, replace the 3/8" bolt.

ADJUST BOTH DOOR LATCH CAMS SIMULTANEOUSLY - ROTATE BOTH LATCH CAMS THE SAME AMOUNT IN THE SAME DIRECTION.

THE DOOR IS AN IMPORTANT PART OF THE STRUCTURAL INTEGRITY OF THE TONG. IT IS IMPERATIVE TO KEEP A SECURE FIT AT THE DOOR IN ORDER TO MAINTAIN PROPER GEAR ALIGNMENT, AND TO MINIMIZE THE POSSIBILITY OF DAMAGE TO THE GEAR TRAIN WHEN OPERATING THE TONG AT SPECIFIED TORQUE. A CLOSED DOOR ALSO ENSURES SAFETY OF OPERATING PERSONNEL.

ILLUSTRATION 3.E.2: DOOR LATCH ADJUSTMENT CAMS

3. Door Alignment

Each door weldment is equipped with two set screws, along with jam nuts to lock position, to align the door when it is in the closed position.

Initial Alignment

Ensure tong doors are closed, and inspect how one door aligns with the other at the point at which they meet. If misalignment is seen, choose one or the other door to adjust. Use a box-end wrench to loosen the lock nuts on the insides of the door weldment - the nuts may be accessed from the side of the door weldment. Use a hex key to turn the hex head set screws either clockwise or counter-clockwise to adjust the door. Note that the top and bottom of the door weldment may not need to be adjusted equally - each set screw should be adjusted independently until the doors are aligned.

Final Alignment

Rotate the cage plate, and stop it when the inside circumference of the door is completely covered. Perform three measurements (see illustration below):

1) From the insides of the outer edge of each door weldment to the cage plate (2 measurements total).

2) From the exact centre point (where the two doors meet) to the cage plate.

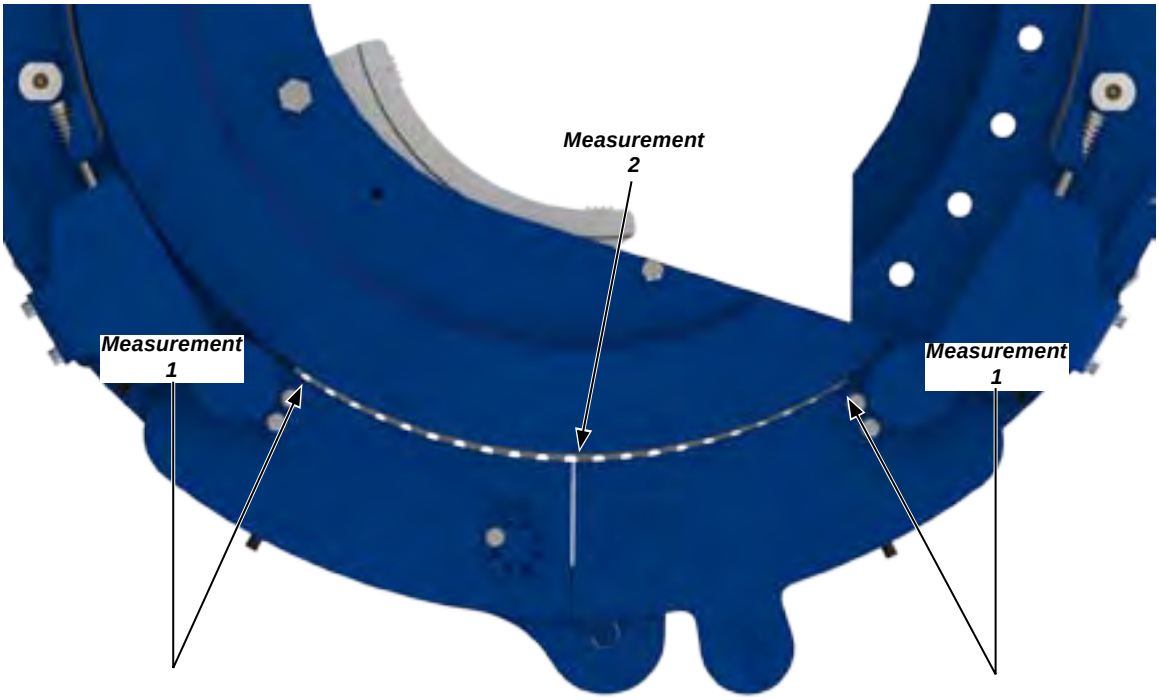


ILLUSTRATION 3.E.3: DOOR ALIGNMENT MEASUREMENT POINTS

The three measurements should be equal. If the centre measurement is less than the two outside measurements, loosen all four locking nuts on the set screws, and turn all four set screws EQUALLY clockwise, until the centre measurement is equal to the two outer measurements. If the centre measurement is more than the two outside measurements, loosen all four locking nuts on the set screws, and turn all four set screws EQUALLY counter-clockwise, until the centre measurement is equal to the two outer measurements. Ensure that the locking nuts are tightened when this procedure is complete.

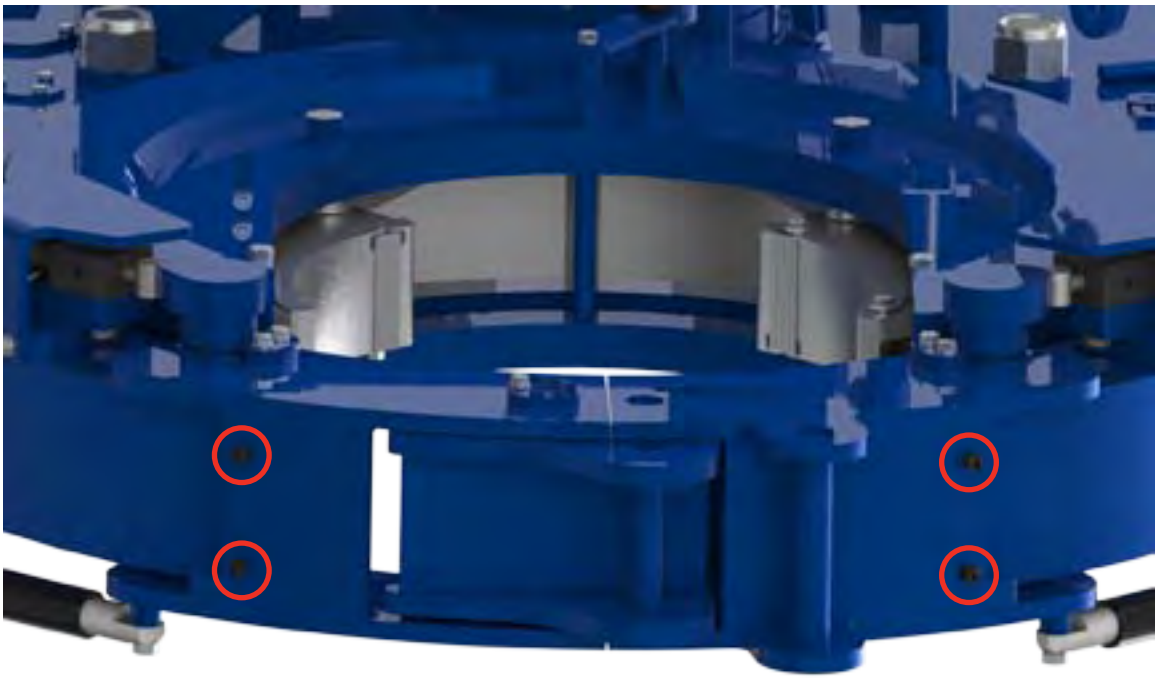


ILLUSTRATION 3.E.4: DOOR ALIGNMENT ADJUSTMENT SET SCREWS

4. Shifter Detent Force Adjustment:

Over time wear to the shifting shaft, wear to the detent ball, and loss of spring tension in the detent spring may result in a loose or "sloppy" fit within the top shifter bushing. The detent pressure may be increased or otherwise adjusted by loosening the 7/16" UNF locking jam nut, and turning the 7/16" UNF detent bolt. Should adequate detent action not be achieved, the shifting shaft, detent ball, or detent spring (or possibly all three) may need to be replaced *(see Pp. 5.16 - 5.17).*

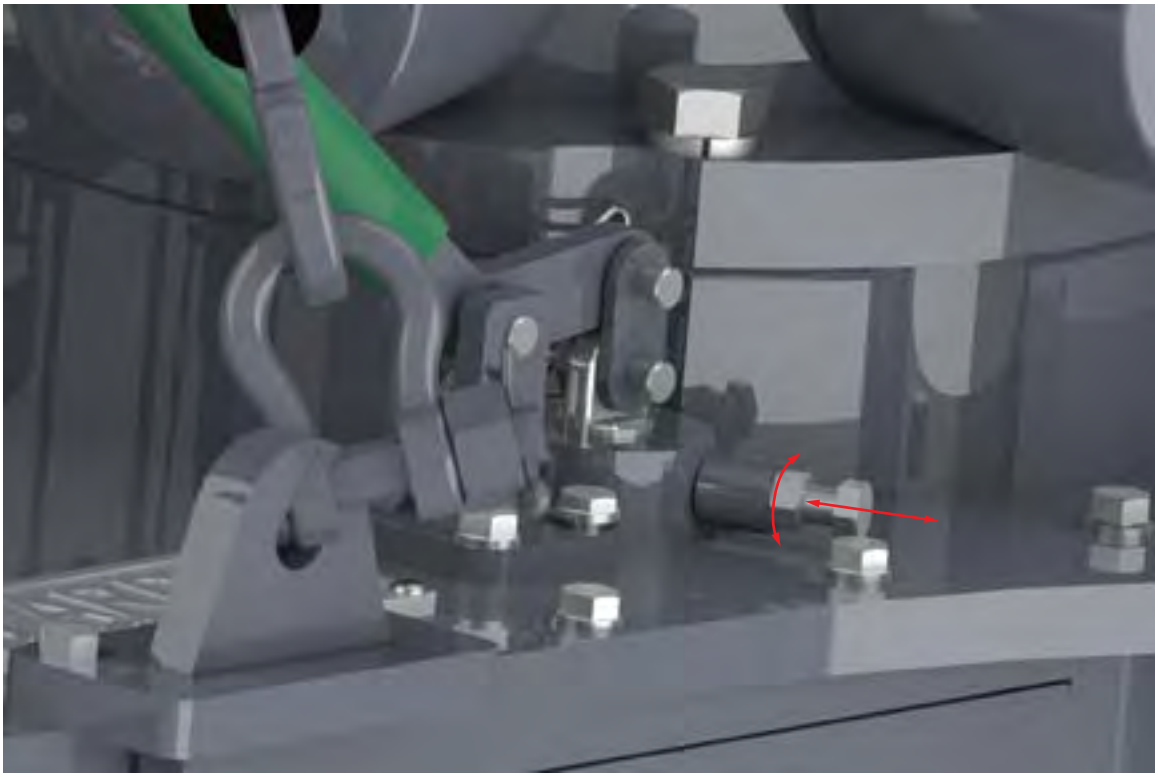


ILLUSTRATION 3.E.5: SHIFTER DETENT FORCE ADJUSTMENT

F. RECOMMENDED PERIODIC CHECKS

1. DOOR STOP SPRING

The spring inside the actuator cylinder must be of sufficient strength to enable the door latch mechanism to snap closed properly, and to hold the door in the open position when opened. Door stop spring fatigue will result in sluggish latch operation. Replace the latch spring inside the cylinder when this occurs.

2. BACKING PIN

Perform a visual inspection of the backing pin after each job. Replace the pin if stress cracks or excessive wear is found, or if either pin is bent.

3. SHIFTING SHAFT

The shifting yoke is secured to the shifting shaft by one hex jam nut above the shifting yoke, and one locknut on the bottom of the yoke. Check these nuts after each job. Do this by removing the clutch inspection plate and ensuring a snug fit prior to lubrication.

4. TORQUE GAUGE ASSEMBLY

Periodic calibration of the torque gauge is recommended to assure accurate torque readings. When having the torque gauge serviced and calibrated, it is critical to note the arm length of the tong, as indicated in the "Specifications" section. Farr recommends that the torque gauge assembly be calibrated yearly. Periodically check to ensure the load cell is filled with oil (see Section 6).

G. OVERHAUL PROCEDURES

The tong may be overhauled following the disassembly instructions in the following procedure. Access to the gear train is possible by removing the top plate of the tong.

ALL MAINTENANCE AND OVERHAUL SHOULD BE PERFORMED FROM THE TOP. THE BOTTOM PLATE OF THE TONG IS TYPICALLY WELDED TO THE SIDE BODY AND CANNOT BE REMOVED.

REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

TOP PLATE REMOVAL:

1. *Remove load cell assembly and load cell pins while tong is suspended (if equipped).*
2. *Securely support tong from the bottom. Ensure the supports are capable of supporting the entire weight of the tong.*
3. *Use a crane to remove the chain sling assembly. Store the chain sling in a location in which it will not be subjected to mechanical damage or corrosion.*
4. *Remove jaw assemblies if not already done.*
5. *Disconnect the hydraulic connections to the motor. Disconnect the hydraulic connections from the safety door switch. Contain hydraulic fluid spilled from disconnected lines and dispose in accordance with your company's environmental policies.*
6. *Undo the restraints securing the inlet and outlet lines connections to their supports, and use a crane to lift the hydraulic valve section away from the tong.*
7. *Remove the mounting posts for the valve bank. Remove the inlet and outlet support brackets.*
8. *Remove the torque gauge mount assembly from the rear top plate of the tong.*
9. *Remove the four tong hangers.*
10. *Remove the top and bottom brake band assemblies.*
11. *Remove the tong doors:*
    - *i. Remove the door cylinders.*
    - *ii. Remove the thin nylock nuts and flat washers from the bottom of the two door pivot roller shafts.*
    - *iii. Ensure the door assemblies are well-supported when performing this next step. One door at a time, use a soft alloy material (e.g. brass rod, etc.) to lightly tap the shafts up through the support roller assembly until the shafts and large washers come free at the top. Use caution that the threads on the ends of the support roller shafts are not damaged.*
12. *Disconnect the shifting handle from the shifting shaft and shifting lug.*
13. *Remove the motor from the motor mount. Staffa motors are secured with five 3/4" bolts, while Rineer motors are secured with six 5/8" bolts. Inspect the splined motor shaft for clashing or spline damage.*
14. *Remove the motor mount by removing the five socket head cap screws. The motor mount can be lifted out of place. Take care not to lose the two position dowels - one, or both, may come off with the mount.*
15. *Remove the access panel on the body side adjacent to shifter assembly. Back off the detent adjustment bolt on the top shifter bushing. Remove the 7/8" jam nut from the shifting shaft to loosen the shifting fork. The shifting shaft may now be carefully rotated and pulled out of the top shifter bushing.*

THE CAGE PLATE BOLTS ARE THE ONLY ITEMS FASTENING THE BOTTOM CAGE PLATE TO THE TONG. SUPPORT THE BOTTOM CAGE PLATE FROM BELOW PRIOR TO REMOVING CAGE PLATE BOLTS IN ORDER TO PREVENT DAMAGE TO THE BOTTOM CAGE PLATE OR PERSONAL INJURY TO THE MECHANIC

16. *Remove the 3/8" hex bolt connecting the backing pin to the rear cage plate bolt. Remove the backing pin.*
17. *Remove the two front cage plate bolts, and the rear cage plate bolt, and the cage plate spacers. The cage-plates may now be removed. Use caution not to damage the cam followers while removing the cage plates.*
18. *Pull the top bearing cap and spacer for the pinion drive gear by removing the four 5/8" bolts which secure the bearing cap. Thread two of the removed bolts into the extra holes on top of the bearing cap, and use them as lifting lugs to lift the bearing cap out of place.*

IF THE BEARING REMAINS ATTACHED TO THE GEAR SHAFT AFTER THE BEARING CAP IS PULLED, MCCOY SERVICE PERSONNEL RECOMMENDS LEAVING IT IN PLACE UNTIL THE TOP TONG PLATE IS REMOVED.

19. *Remove the top 1-1/2" nylock nuts and pads for the rotary and pinion idler gears.*
20. *Remove the thin nylock nuts and washers from all support roller shafts. One at a time, use a soft alloy material (e.g. brass rod, etc.) to lightly tap the shafts up through the support roller assemblies until the shafts and flat washers come free at the top. Use caution that the threads on the ends of the support roller shafts are not damaged. Note that the brake band lug weldments will come free when the support roller shafts are removed.*
21. *Remove the top plate fasteners (hex head bolts & socket head cap screws) around the perimeter of the tong which secure the top plate to the gear case housing. Note that the rear door cylinder mounting lugs must also be removed to release the top plate.*
22. *With all the above steps taken, the top tong plate can be lifted off providing access to the inside of the gear case. Use this opportunity to inspect the cam follower array mounted on the top plate - replace damaged cam followers.*

H. ASSEMBLY PROCEDURES

Assembly of Farr Hydraulic Power Tongs is simple, and can be accomplished without the use of special tools. The instructions on this page are presented as a guide only, and are similar to the assembly sequence our technician would use while assembling the tong in our plant.

TIGHTENING TORQUE GUIDE			
SAE GRADE 8 - FINE THREAD			
SIZE	**CLAMP LOAD**	**PLAIN**	**PLATED**
1/4 - 28 (.250)	3,263	14 ft. lbs.	10 ft. lbs.
5/16- 24 (.3125)	5,113	27 ft. lbs.	20 ft. lbs.
3/8 - 24 (.375)	7,875	49 ft. lbs.	37 ft. lbs.
7/16 - 20 (.4375)	10,650	78 ft. lbs.	58 ft. lbs.
1/2 - 20 (.500)	14,400	120 ft. lbs.	90 ft. lbs.
9/16 - 18 (.5625)	18,300	172 ft. lbs.	129 ft. lbs.
5/8" - 18 (.625)	23,025	240 ft. lbs.	180 ft. lbs.
3/4 - 16 (.750)	33,600	420 ft. lbs.	315 ft. lbs.
7/8" - 14 (.875)	45,825	668 ft. lbs.	501 ft. lbs.
1 - 12 (1.000)	59,700	995 ft. lbs.	746 ft. lbs.
1 - 14 (1.000)	61,125	1019 ft. lbs.	764 ft. lbs.
1 1/8 - 12 (1.125)	77,025	1444 ft. lbs.	1083 ft. lbs.
1 1/4 - 12 (1.125)	96,600	2012 ft. lbs.	1509 ft. lbs.
1 3/8 - 12 (1.375)	118,350	2712 ft. lbs.	2034 ft. lbs.
1 1/2 - 12 (1.500)	142,275	3557 ft. lbs.	2668 ft. lbs.
SAE GRADE 8 - COARSE THREAD			
SIZE	**CLAMP LOAD**	**PLAIN**	**PLATED**
1/4 - 20 (.250)	2,850	12 ft. lbs.	9 ft. lbs.
5/16- 18 (.3125)	4,725	25 ft. lbs.	18 ft. lbs.
3/8 - 16 (.375)	6,975	44 ft. lbs.	33 ft. lbs.
7/16 - 14 (.4375)	9,600	70 ft. lbs.	52 ft. lbs.
1/2 - 13 (.500)	12,750	106 ft. lbs.	80 ft. lbs.
9/16 - 12 (.5625)	16,350	153 ft. lbs.	115 ft. lbs.
5/8" - 11 (.625)	20,325	212 ft. lbs.	159 ft. lbs.
3/4 - 10 (.750)	30,075	376 ft. lbs.	282 ft. lbs.
7/8" - 9 (.875)	41,550	606 ft. lbs.	454 ft. lbs.
1 - 8 (1.000)	54,525	909 ft. lbs.	682 ft. lbs.
1 1/8 - 7 (1.125)	68,700	1288 ft. lbs.	966 ft. lbs.
1 1/4 - 7 (1.125)	87,225	1817 ft. lbs.	1363 ft. lbs.
1 3/8 - 6 (1.375)	103,950	2382 ft. lbs.	1787 ft. lbs.
1 1/2 - 6 (1.500)	126,450	3161 ft. lbs.	2371 ft. lbs.

ALL FASTENERS USED DURING REASSEMBLY OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE. THREADED FASTENERS USED IN LOAD-BEARING DEVICES MUST BE SECURED WITH RED LOC-TITE™. CHECK ALL CHAINS FOR DAMAGE BEFORE PLACING UNDER LOAD. DO NOT ALLOW CHAINS TO KINK BEFORE PLACING UNDER LOAD.

APPLY A THIN LAYER OF GREASE TO THE SURFACE OF EACH MOVING PART DURING ASSEMBLY TO AID IN THE ASSEMBLY PROCESS.

1. *Position the tong body gear case on a suitable stationary support such that the bottom body plate is accessible.*
2. *Install 25 cam followers (PN 1037-0-58) into the bottom plate as shown in the illustration. Secure each with a 7/8" lockwasher and 7/8" UNF jam nut.*

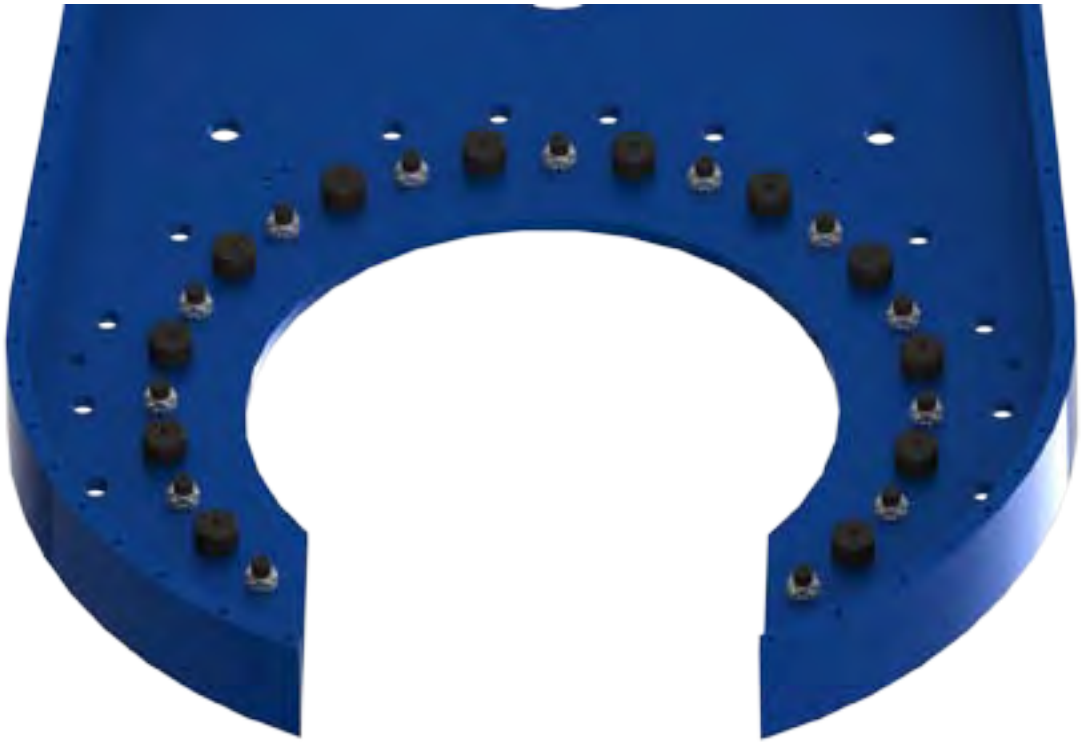


ILLUSTRATION 3.H.1: CAM FOLLOWER INSTALLATION - BOTTOM PLATE

3. *Insert support roller inner spacer (PN 1037-C-134) into each support ("dumbbell") roller. Press two support roller bearings (PN 02-0094) into each end of each support roller (16 assemblies total). Once the assembly of the support rollers is complete, temporarily slide the support roller shafts into each assembly for assistance in correctly positioning each support roller. NOTE: do not include the two door pivot rollers in this step - only perform this action with the fourteen body rollers.*
4. *Place rotary gear on bottom plate, over the cam followers installed in Step 2. Note that the backing pin grooves are in the top side of the rotary gear*
5. *Rotate the rotary gear so that the opening in the gear faces the first three support roller positions closest to the mouth of the tong (do not include door pivot rollers at this point). Install three support roller assemblies, including shafts but not including fasteners, in the locations exposed in the rotary gear opening. Continue to rotate rotary gear around the tong, installing the support roller assemblies as the gear is rotated. Finish with the rotary gear aligned with the opening in the bottom plate.*

Assembly Procedures (Cont'd):

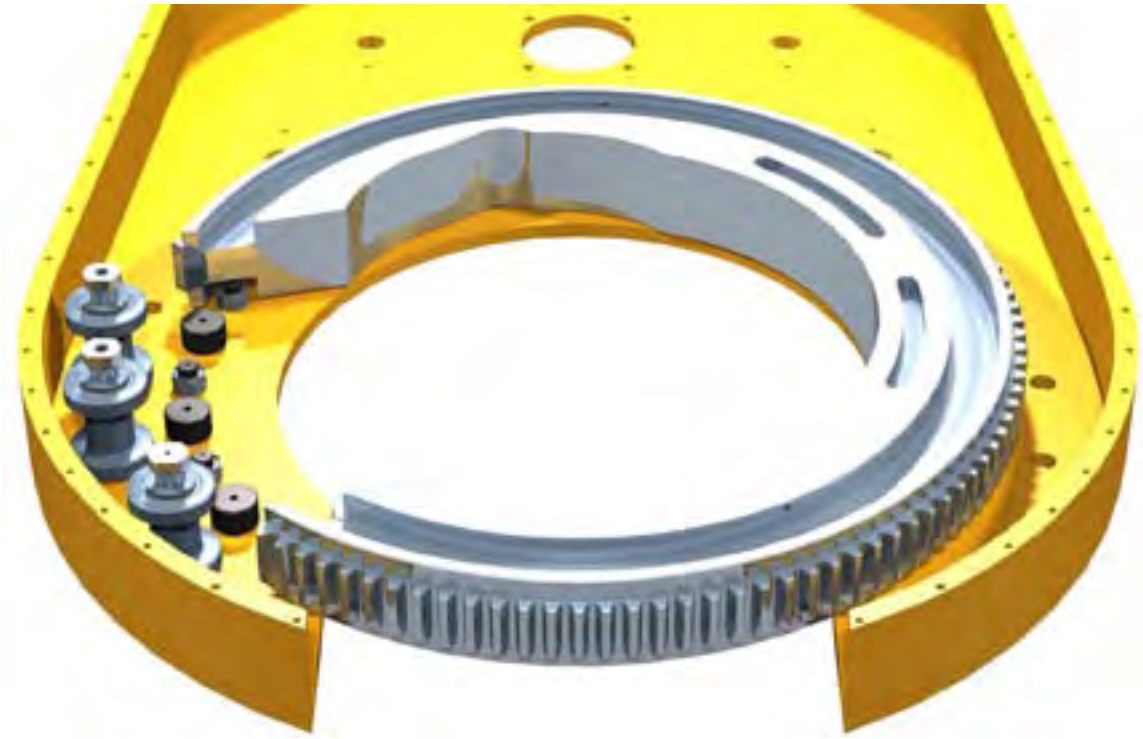


ILLUSTRATION 3.H.2: ROTARY GEAR & SUPPORT ROLLER INSTALLATION

6. *Press pinion bearing (PN 02-0106) into bottom pinion bearing cap (PN 1037-C-33), and install bearing cap into bottom plate of tong using four 5/8" SS lock washers and four 5/8" NC x 1-1/2" hex cap screws.*
7. *Press lower clutch bearing (PN 02-0105) into bottom clutch bearing cap (1037-C-17), and install bearing cap into bottom plate of tong using four 5/8" lock washers and four 5/8" NC x 1-1/2" hex cap screws.*
8. *Install a retaining ring (PN 02-0009) into each of the two rotary idler gears (one each of PN 1037-D59). Press one each of the idler bearings (PN 02-0011) into each of the rotary idler gears, followed by a second retainer ring in each. Slide each rotary idler gear and bearing assembly over an idler shaft (PN 1050-D5-117) and centre as well as you are able.*
9. *Slide a bearing seal (PN 02-0010) over each end of the rotary idler shafts, ensuring that the "lip" on the seals are towards the centre bearing, followed by an idler spacer (PN 1050-D5-121) over each end of the shafts.*
10. *Install each rotary idler in their respective locations in the bottom plate.* ***ASSEMBLY NOTE:*** *when the rotary idler assemblies are placed vertically, the bearing seal and idler spacer on the bottom side will have to be held in place by hand as the assembly is lowered through the bottom plate. Once the assembly is through the bottom plate, place an idler pad (PN 997-D20-125) over the bottom end of each shaft, and secure the pads with a 1-1/2" UNF hex nylock nut.*
11. *Slide low pinion gear (PN 1037-D-32) over bottom end of pinion gear shaft (PN 1037-D-15), and place end of pinion gear shaft into pinion bearing and bearing cap installed in Step 6. Ensure the gear keys (PN 1037-D-15A), are placed into the pinion gear shaft before installing gear (two keys per gear).*
12. *Install a retaining ring (PN 02-0009) into each of the two pinion idler gears (PN 1037-D-1). Press one each of the idler bearings (PN 02-0011) into each of the pinion idler gears, followed by a second retainer ring in each. Slide each pinion idler gear and bearing assembly over an idler shaft (PN 1050-D5-117) and centre as well as you are able.*
13. *Slide a bearing seal (PN 02-0010) over each end of the pinion idler shafts, ensuring that the "lip" on the seals are towards the centre bearing, followed by an idler spacer (PN 1050-D5-121) over each end of the shafts.*
14. *Install each pinion idler in their respective locations in the bottom plate.* ***ASSEMBLY NOTE:*** *when the pinion idler assemblies are placed vertically, the bearing seal and idler spacer on the bottom side will have to be held in place by hand as the assembly is lowered through the bottom plate. Once the assembly is through the bottom plate, place an idler pad (PN 997-D20-125) over the bottom end of each shaft, and secure the pads with a 1-1/2" UNF hex nut.*
15. *Slide clutch bearing (PN 02-0104) over the bottom end of the splined clutch shaft (PN 1037-D-38). Install two upper clutch bearings (PN 02-0103) over the top side of the clutch shaft. Press bearings tight to the center gear on the splined clutch shaft.*
16. *Slide the low clutch gear (PN 1037-D-40) over the lower bearing so that the larger diameter gear on the low clutch gear is tight to the center gear on the clutch shaft, and place end of clutch shaft into bottom clutch bearing installed in Step 7. Mesh the low clutch gear with the low pinion gear as it is installed.*

Assembly Procedures (Cont'd):

17. *Place the shifting collar (PN 1037-D-34) over the middle section of the clutch shaft.*
18. *Slide the high clutch gear (PN 1037-D-41) over the two top clutch bearings.*
19. *If not already done, insert the two remaining gear keys in the pinion gear shaft. Install the high pinion gear (PN 1037-D-12) over the top of the pinion gear shaft, meshing with the high clutch gear as it is installed.*
20. *Fasten the lower shifter bushing (PN 1037-C-21B) to the bottom plate with four 3/8" NC x 1-1/4" hex bolts and 3/8" lock washers.*
21. *Place the shifting fork weldment (PN 1037-D-27) up against the shifting collar, roughly in its final position.*
22. *Install 25 cam followers (PN 1037-0-58) in the top plate (PN 1037-7-02) as shown in the illustration below. Secure with 7/8" UNF jam nuts and 7/8" lock washers.*

ILLUSTRATION 3.H.3: TOP PLATE CAM FOLLOWER INSTALLATION

23. *Carefully remove all the support roller shafts, ensuring the support roller assemblies do not shift position as you are doing so.*
24. *Insert three 3/8" x 1-1/2" hardened ground production dowel pins into the side body - one at exact rear centre, and one on either side of the front opening. Position the top plate in its proper location - use caution not to damage threads when aligning the top plate with the idler and support roller shafts. Ensure the plate is aligned exactly horizontal to prevent binding on the dowel pins. Use caution when aligning the previously installed cam followers with the rotary gear. Tap plate securely into place with a rubber mallet.*
25. *Secure the top plate with twenty-seven 3/8" NC x 1-1/2" hex bolts, two 3/8" NC x 1-1/4" hex bolts (install these two above the removable access panel), and eight 3/8" NC x 1" hex socket cap screws. Note that fasteners are NOT to be installed at the chain sling hanger locations, circled in red in illustration 3.H.4 on the next page.*

Assembly Procedures (Cont'd):

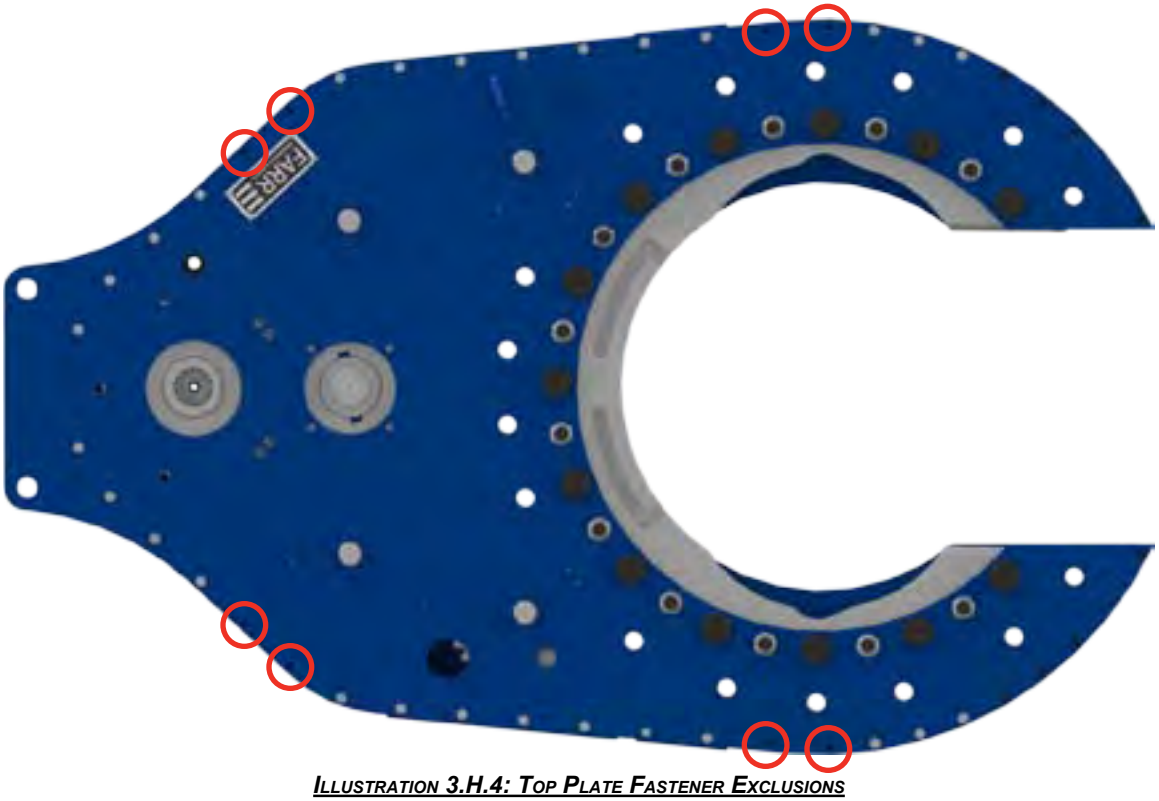


ILLUSTRATION 3.H.4: TOP PLATE FASTENER EXCLUSIONS

26. *Install ten horizontal cam follower guides (PN 1037-A-49) to the top side of the top plate, and secure with 1/4" NC x 1-1/4" hex socket head cap screws and 1/4" high-collar lock washers. Install ten horizontal cam followers (PN 02-0108) in the horizontal cam follower guides and secure each with a 7/16" UNF jam nut and 7/16" lock washer.*

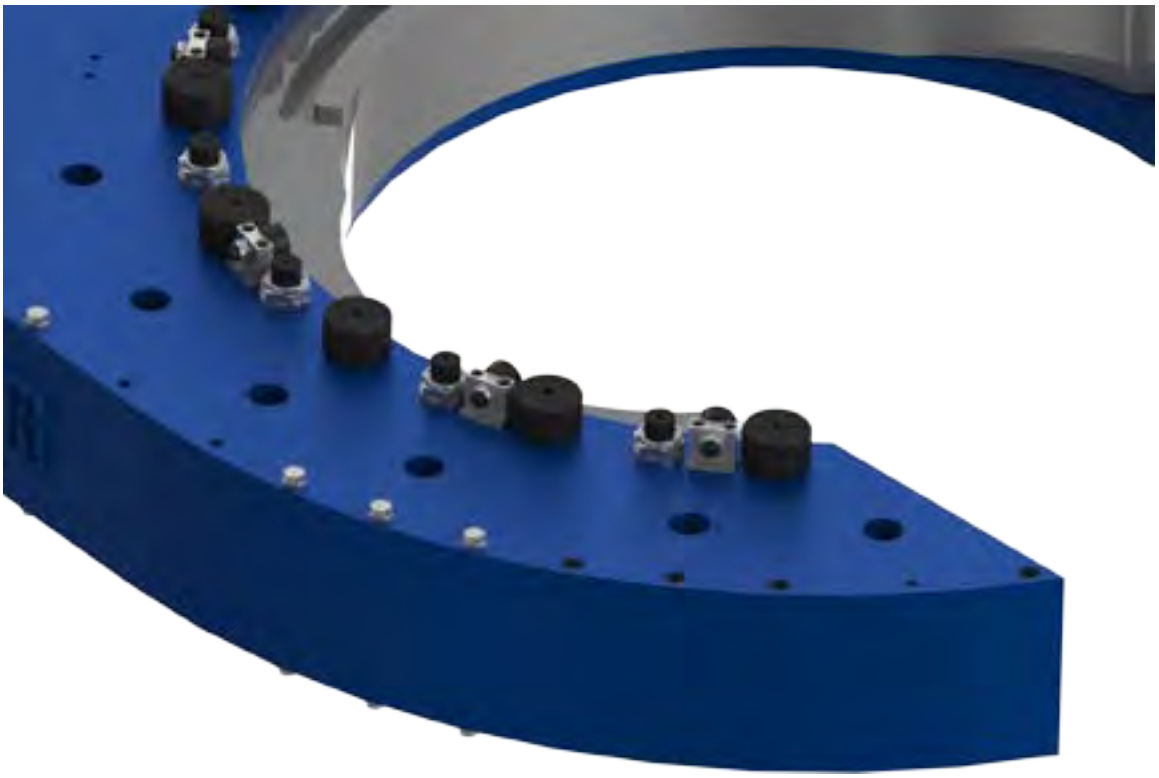


ILLUSTRATION 3.H.5: INSTALLATION OF HORIZONTAL CAM FOLLOWERS AND GUIDES

Assembly Procedures (Cont'd):

27. *Re-install the support roller shafts:*

    Note that the two top and bottom brake band lug weldments (top RH and bottom LH weldments are PN 101-1636, and the top LH and bottom RH weldments are PN 101-1637) are retained by four support roller shafts (as shown in illustration below). Secure the support roller shafts with 1" UNF thin nylock nuts and 1" narrow flat washers (except where noted).

    ASSEMBLY NOTE: *1" narrow flat washers are not used where the support roller shafts are coincidental with the brake band lug weldments.*

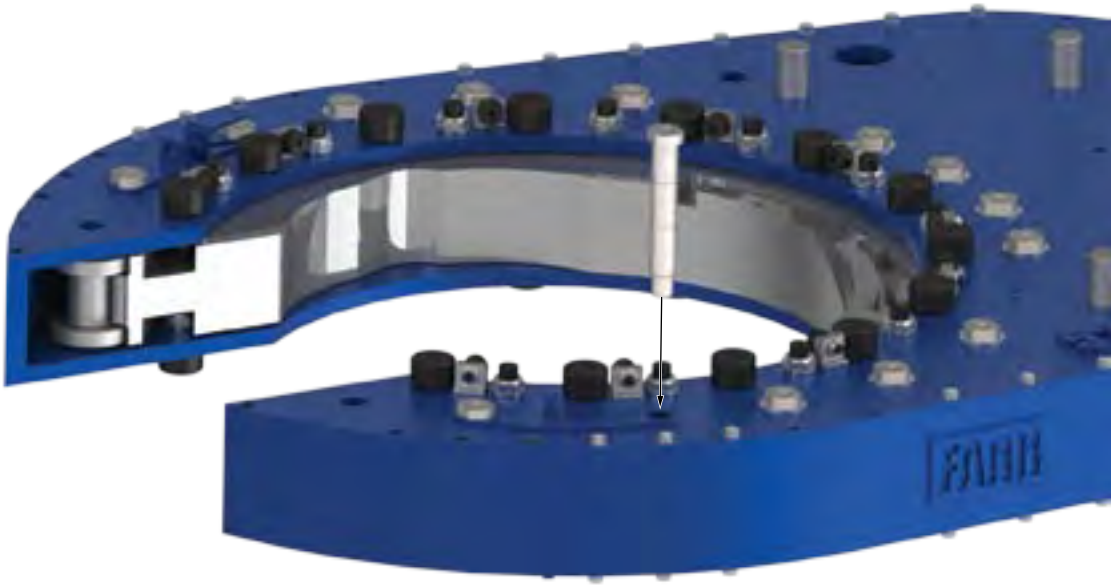


ILLUSTRATION 3.H.6: SUPPORT ROLLER - BRAKE BAND WELDMENT INSTALLATION

28. *Install the remaining 1-1/2" UNF nylock nuts and idler pads over the tops of the four idler assemblies.*
29. *Press the remaining bearing in the pinion assembly into the top pinion bearing cap (PN 1037-C-10), and install the bearing cap in the top plate of the tong using four 5/8" lock washers and four 5/8" NC x 1-1/2" hex cap screws. Note that the flat on the bearing cap faces toward the rear of the tong.*
30. *Install motor mount and motor:*

    TONGS EQUIPPED WITH THE RINEER MOTOR OPTION:

    i. *Install the Rineer motor mount (PN 1426-7) on to the top plate. Correct orientation is such that one flat is against the flat on the top pinion bearing cap, and the second flat is on left side, directly adjacent to the clutch access panel. Secure the motor mount with five 3/4" NC x 1-1/4" hex socket head cap screws and 3/4" lock washers.*

    ii. *Install the top clutch shaft bushing (PN 1037-42) inside the centre of the motor mount.*

    iii. *Install Rineer hydraulic motor (PN 87-0150) on to the motor mount. Use caution to make sure the splines on the motor shaft are properly aligned with the grooves in the clutch shaft. Secure with five 3/4" NC x 2-1/2" hex bolts and 3/4" lock washers.*

    TONGS EQUIPPED WITH THE STAFFA MOTOR OPTION:

    i. *Place the motor thrust washer (PN 101-3289) over the top of the splined clutch shaft, followed by the motor spacer (PN 1037-D-38S).*

    ii. *Install the motor mount (PN 1037-D-7) ensuring that the flat on the motor mount is oriented toward the pinion bearing cap and the "notch" in the motor mount is oriented to accommodate the top shifter bushing. Secure with five 3/4" NC x 1-1/4" hex socket head cap screws and 3/4" lock washers.*

    iii. *Install Staffa hydraulic motor (PN 87-0210B) on to the motor mount. Use caution to make sure the splines on the motor shaft are properly aligned with the grooves in the clutch shaft. Secure with five 3/4" NC x 2-1/2" hex bolts and 3/4" lock washers.*

31. *Guide the shifting shaft (PN 1037-C-20A) through the top shifter bushing, and secure to shifting fork weldment using two 7/8" UNF hex jam nuts. Once the shifting fork has been secured, place the bottom of the shifting shaft into the lower shifting bushing.*
32. *Attach the "toe" of the shifting handle weldment (PN 1037-D-20B) to the shift pivot lug weldment using a 5/16" x 1-1/2" clevis pin, and secure the clevis pin with a small hitch pin.*
33. *Bolt the shifter lug weldment (PN 101-0016) to the top plate next to the top shifter bushing using four 3/8" UNC x 1" hex bolts and 3/8"*

Assembly Procedures (Cont'd):

33. *Connect the shifting handle weldment to the shifting shaft using two shifting links (PN 02-0120) and two 5/16" x 1-1/2" clevis pins. Secure the clevis pins with small hitch pins.*
34. *Insert the shifter detent ball (PN 02-0018) into the detent tube on the top shifter bushing. Insert the shifter detent spring (PN 997-0-64) into the detent tube. Thread a 7/16" UNF jam nut on to the 7/16" UNF x 1-1/4" hex bolt, and then thread the bolt into the end of the detent tube. Lock the bolt to the detent tube with the hex nut. See Section 3.E.4 for information about adjusting the shifter detent tension.*
35. *Position the top cage plate (PN 101-1580) on the top plate of the tong over the previously installed cam followers.*
36. *Position the bottom cage plate (PN 1037-D-51) against the bottom plate of the tong over the previously installed cam followers, and support until it is attached to the top cage plate. Secure the bottom cage plate to the top cage plate using two 1" NC x 8" hex bolts and the rear cage plate bolt (PN 1037-36). Do not neglect to install the three cage plate spacers (PN 1037-C-38) between the top and bottom cage plates.*

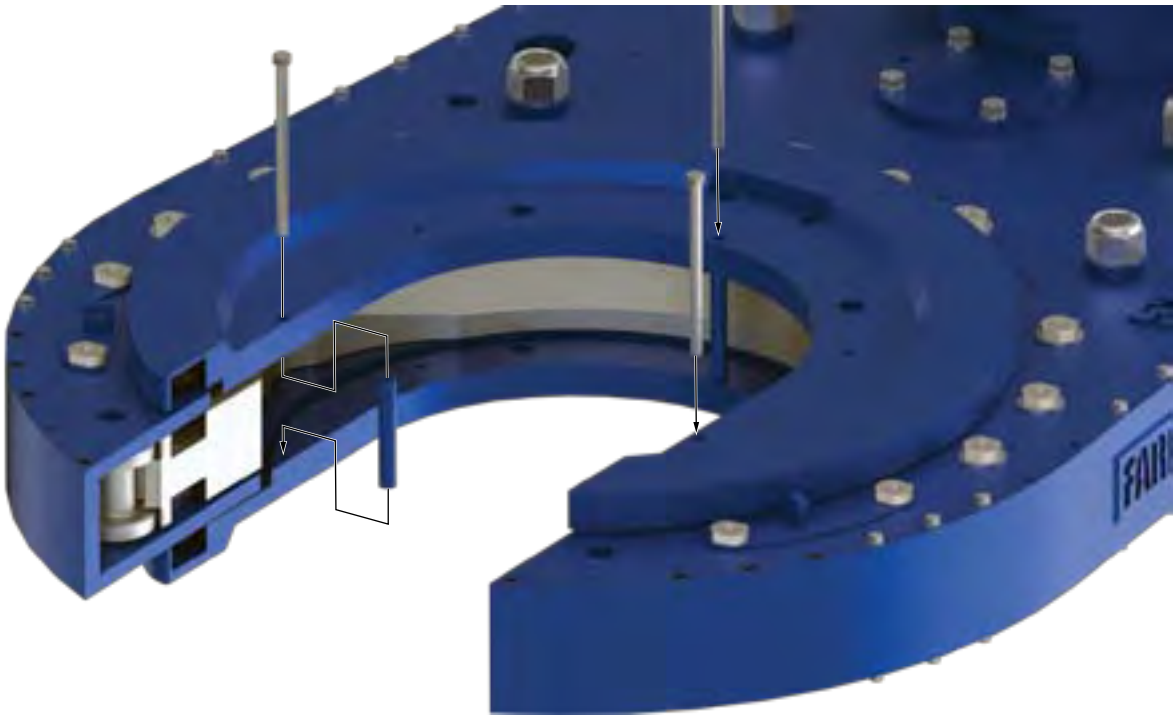


ILLUSTRATION 3.H.7: TOP & BOTTOM CAGE PLATE INSTALLATION

37. *Press the four door pivot shoulder bushings (PN 101-0110) into the RH door weldment (PN 101-1703) and the LH door weldment (PN 101-1697). The bushings are installed so that the shoulders are towards the inside of the weldments.*
38. *Install latch weldment (PN 101-1570) onto RH door assembly (see Pp. 5.28 - 5.29). Install two latch springs between the latch weldment and the door weldment, and secure latch to RH door using the door latch shaft (PN 1037-C-200) and two latch cam plates (PN 1037-C-151). Secure each latch cam plate to the top and bottom door plates with one 3/8" UNC x 1-1/4" hex bolt and 3/8" lock washer.*
39. *If not already done install the door pivot roller components that fit between the two body plates, i.e. everything except the roller shafts, nuts, washers, and door stop spacers.*
40. *Install the threaded door spring cylinder posts (101-0446), one on each side of the top plate, adjacent to the brake band lug weldments on the top plate (see illustration 3.H.8 next page)*

Assembly Procedures (Cont'd):

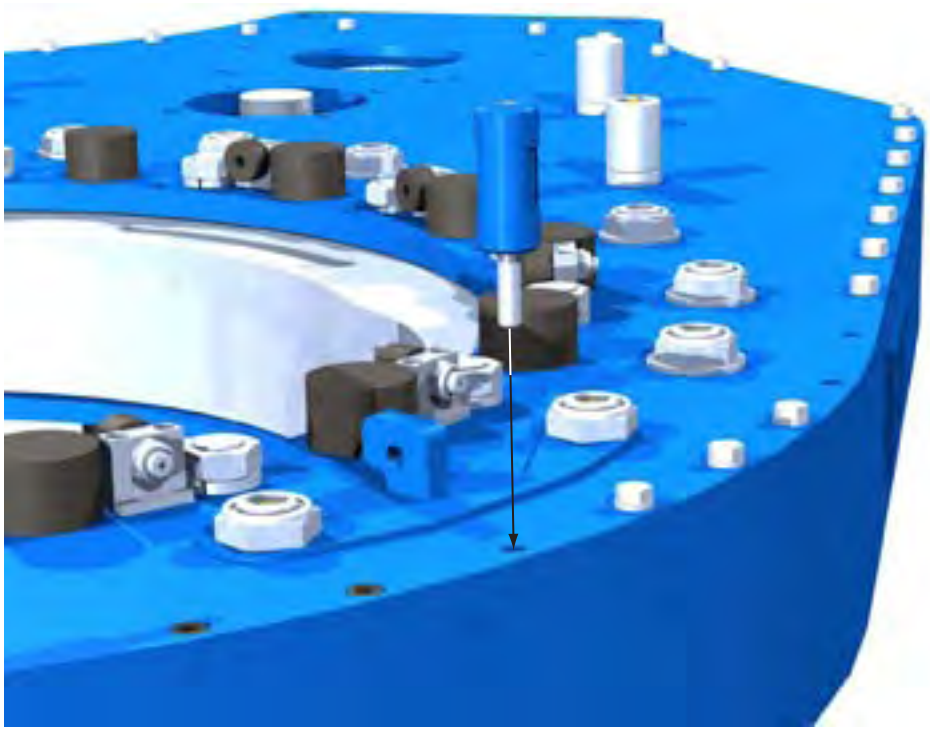


ILLUSTRATION 3.H.8: DOOR SPRING CYLINDER POST INSTALLATION

41. *Thread two 1/2" UNC x 1-1/4" hex socket head set screws into each door assembly. Thread far enough through the door weldments that a 1/2" jam nut can be threaded on to each set screw from the inside of the door assemblies.*
42. *Slide a 1-1/8" wide flat washer on to each door pivot roller shaft (PN 101-3940). Position the RH door assembly in its proper location, and insert a door pivot shaft from the top through the door assembly and the support roller components. Secure the door pivot shaft on the bottom using a 1" wide flat washer and 1" UNS thin nylock nut. Repeat the installation procedure for the LH door assembly.*
43. *Install the door spring cylinders (PN 1037-A4-144) using 5/8" x 3/4" UNC hex socket head shoulder bolts.*
44. *Install top and bottom lined brake band weldments (PN 1037-D-63). Fasten each brake band weldment to the top and bottom body plates with two brake band retainers (PN 101-1631), securing each retainer with two 3/8" NC x 1" hex bolts and 3/8" lock washers. Fasten the ends of the brake bands to the brake band lug weldments using two 3/8" NC x 4-1/2" adjustment bolts and 3/8" NC hex nylock nuts per brake band, one per side. Ensure that the adjustment spring (PN 08-9264) is installed between the head of the adjustment bolt and the tab on the brake band weldment (four locations - see Pp. 5.22-5.23).*
45. *Install the backing pin assembly:*
    - i. *Drop the backing pin (PN 1037-C-39A) into one of the two backing pin receiver holes in the top cage plate..*
    - ii. *Place the backing pin retainer (PN 1037-B-54) over the rear cage plate bolt and the backing pin: ASSEMBLY NOTE: Ensure the larger diameter hole in the retainer slides over the backing pin.*
    - iii. *Secure the backing pin retainer to the rear cage plate bolt using a 3/8" UNC x 3/4" hex bolt and regular 3/8" flat washer.*
    - iv. *Thread the backing pin knob (PN 02-0017) on to the backing pin.*
46. *Install the safety door components (if equipped):*
    - i. *Attach RH safety door latch plate (PN 101-0479) to the RH door weldment using two 3/8" UNC x 1-1/2" hex bolts and lock washers and two 3/8" UNC x 1-1/2" flat head countersunk cap screws.*
    - ii. *Attach RH safety door latch block (PN AE13-302M) to the RH safety door latch plate.*
    - iii. *Attach LH safety door latch plate (PN 101-0915) to the LH door weldment using three 3/8" UNC x 1-1/2" flat head countersunk cap screws.*
    - iv. *Attach LH safety door latch block (PN AE13-301S) to door latch plate # 2 (PN AE13-311) using three 3/8" UNC x 3/4" flat head countersunk cap screws.*
    - v. *Attach LH safety door latch plate #2 to the LH safety door latch plate using four 5/16" x 3/4" UNC head socket shoulder screws.*

46. *Install the safety door components (continued):*

vi. *Insert load plunger (PN AE12-306) into LH safety door latch block.*

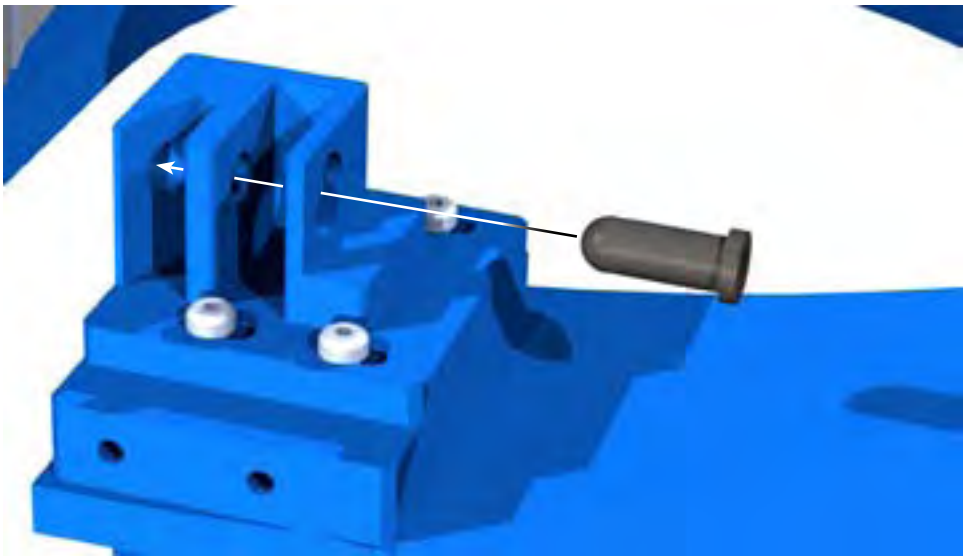


ILLUSTRATION 3.H.9: SAFETY DOOR VALVE LOAD PLUNGER INSTALLATION

vii. *Attach three 1/4" NPT JIC elbows to the Deltrol safety door valve (PN 08-0337M). Position a 15/16" UNC valve lock nut as shown below, and secure the safety door valve to the LH safety door latch block using the valve lock nut.*

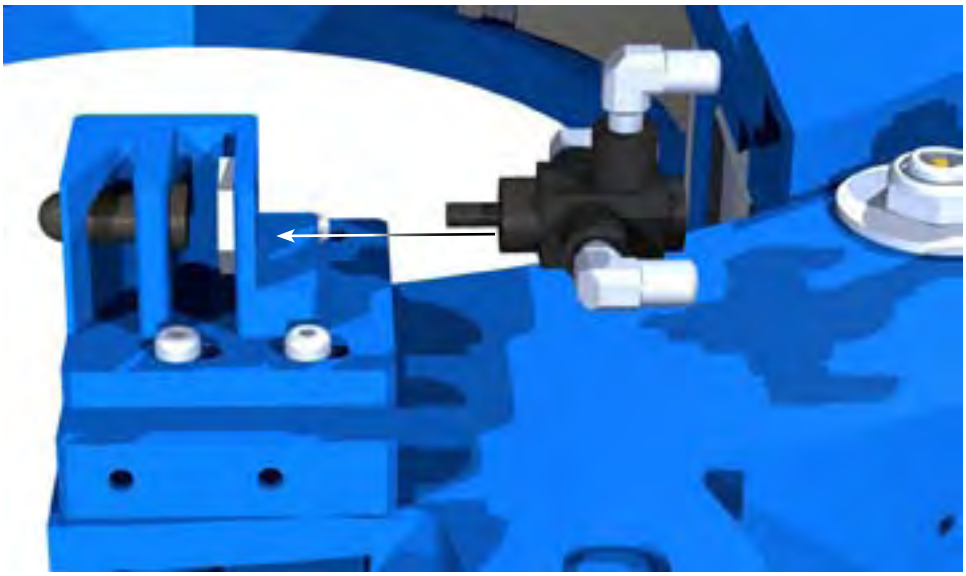


ILLUSTRATION 3.H.10: DELTROL SAFETY DOOR VALVE INSTALLATION

viii. *Attach the safety door protector weldment (PN 101-0450) to the LH safety door latch plate using four 3/8" NC x 1" hex bolts and lock washers. Note that the protector has a removable top plate (PN 101-1238) that is attached to the protector weldment using four 3/8" NC x 3/4" hex bolts and lock washers.*

47. *Attach the hydraulic supports to the top plate:*

i *Attach the hydraulic valve mount weldments (PN 101-1442) to the top plate near the LH rotary idler, using one 3/8" UNC x 1" hex bolt and 3/8" lock washer per mount. ASSEMBLY NOTE: The "toes" on the valve mount weldments face toward the rear of the tong.*

ii *Attach L-shaped support weldment for the 1" hydraulic inlet line (PN 101-1138) to the top plate just behind the RH pinion idler using two 3/8" UNC x 1" hex bolts and 3/8" lock washers.*

iii. *Attach the L-shaped support weldment for the 1-1/4" hydraulic discharge line (PN 101-1138) to the top plate using two 3/8" UNC x 1" hex bolts, two 3/8" narrow washers, and two 3/8" UNC thin nylock nuts.*

Assembly Procedures (Cont'd):

47. *Attach the hydraulic supports to the top plate (continued):*
    - i *Attach the adjustable support plate (PN 101-0022) to the hydraulic inlet support base using two 3/8" UNC x 1" hex bolts, two 3/8" narrow washers, and two 3/8" UNC thin nylock nuts.*
48. *Attach four leg weldments (PN 997-D8-160A) to the bottom plate of the tong using 7/8" UNC x 1-1/2" hex bolts and 7/8" plain narrow flat washers.*
49. *Attach torque gauge holder weldment (PN 101-4465) to the rear of the top plate behind the motor mount using two 3/8" NC x 1" hex bolts and lock washers. Insert the torque gauge mount weldment (PN 1500-09-03A) into the holder weldment and secure with a 0.148" x 3" hitch pin.*
50. *Bolt the hydraulic valve assembly to the hydraulic valve support posts installed in step 47(i) using two 1/2" NC x 4-1/2" hex bolts and 1/2" lock washers. Secure the inlet and outlet plumbing to the support assemblies installed in Step 47.*
51. *Install tong hangers:*
    - i *Attach four tong hanger bracket weldments (PN 101-3985) to the bottom plate using 3/8" NC x 2-1/2" hex bolts and 3/8" lock washers (2 each per weldment).*
    - ii *Attach four tong hanger bracket bases (PN 101-4006) to the top plate using 3/8" NC x 2-1/2" hex bolts and 3/8" lock washers (2 each per base).*
52. *Attach the chain sling to the four chain sling hangers using one shackle and bolt set (PN 02-9063) per hanger.*

DO NOT EXCEED THE SPECIFIED LENGTH OF ANY FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.).

REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

I. DAILY INSPECTION & MAINTENANCE CHECKLIST (POWER TONG)

Farr recommends that the following inspection and maintenance procedures be performed before each use, and at least once per day when the tong is in steady use, in the order in which they are listed.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

2. ☐
   1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
   2) *De-energize the power unit.*
   3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   4) *Remove the hydraulic SUPPLY line from the equipment.*
   5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   7) *Disconnect the hydraulic RETURN line from the equipment.*
   8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Perform an initial wash of the tong in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
5. ☐ *Use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*
6. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners. Farr recommends that damaged or missing body parts be repaired or replaced as soon as possible.*
7. ☐ *Inspect the jaws and dies. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, replace the entire jaw assembly. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely. Check to ensure the size of the loaded jaws match the size of casing or pipe you are running.*
8. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service.*
9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*
10. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
11. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*
12. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object.*

13. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object.*

14. ☐ *Perform a complete greasing of the tong - refer to Maintenance section of the technical manual*

15. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines, and, if applicable, the electrical line to the turns counter.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

16. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

17. ☐ *Perform a visual inspection of pressurized hydraulic lines. Document and correct any hydraulic fluid leaks.*

18. ☐ *Perform a full functional test of the tong. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

19. ☐ *Perform a visual inspection of the load cell. If using a tension load cell, replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*

20. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

21. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*

22. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

23. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved (see section 3.E.1).*

J. MONTHLY MAINTENANCE CHECKLIST - POWER TONG

The following maintenance checklist is intended as a guideline rather than a definitive maintenance schedule. Your equipment may require more, or less, maintenance depending upon the frequency of use, the percentage of maximum torque that your equipment is routinely subjected to, and the field conditions under which your equipment operates. Farr recommends that the following inspection and maintenance procedures be performed monthly, or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

2. ☐

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Clean the exterior of the tool thoroughly, using either water (if using a pressure washer ensure a low-pressure wash wand is used), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*

4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*

5. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*

6. ☐ *Inspect all fasteners and fastener safety wires (if equipped). Replace any missing fasteners - use Grade 8 bolts only unless otherwise specified. Re-torque all external fasteners to SAE specifications.*

7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*

8. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners. Farr recommends that damaged or missing body parts be repaired or replaced as soon as possible.*

9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*

10. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to the tong being returned to service. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "Farr Blue" is paint number RAL5005 (contact Farr sales for paint number for custom paint applications). Allow sufficient time for paint to dry before proceeding.*

11. ☐ *Inspect all external welds. Any weld that is cracked or separating must be repaired and repainted before returning the tong to service.*

12. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. Refer to Section 2A of the technical manual (Sling/Load Bearing Device Safety) for information on recommended testing and recertification. Please note that turnbuckles with part number 101-3086 (short turnbuckles) use a high-strength pin which must be supplied by Farr.*

"SHORT" TURNBUCKLES HAVING PART NUMBER 101-3086 EMPLOY HIGH-STRENGTH PINS WHICH MUST BE SUPPLIED BY FARR.

13. ☐ *Rotate the gear train by hand, and use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear while the gear train is being rotated. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*

14. ☐ *Inspect all jaws and dies in use for the maintenance interval. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, remove and quarantine the jaw until the weld is repaired. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely.*

15. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*

16. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

17. ☐ *Inspect door springs. Ensure the springs retain sufficient strength to be able to assist the opening of the door, and to keep the door open. The springs should also help to "snap" the door shut.*

18. ☐ *Inspect backup springs (if applicable). The rear extension springs should be equally extended, and the front leg springs should be equally compressed. Ensure that neither of the rear backup springs have been over-extended and lack sufficient tension to adequately support the backup. Ensure that neither of the front leg springs have been over-compressed, and still retain enough spring strength to support the front of the backup.*

19. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

20. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object. If your tong is equipped with rigid hydraulic lines, replace any line that is dented or appears to be stressed or cracked.*

21. ☐ *Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear. Perform a full lubrication - refer to Maintenance section of manual to determine lubrication points.*

22. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines, and, if applicable, the electrical line to the turns counter.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

23. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

24. ☐ *Perform a visual inspection of pressurized hydraulic lines. If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

25. ☐ *Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

26. ☐ *Energize power unit. Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train.*

27. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

28. ☐ *Re-energize power unit and extend all hydraulic cylinders. Inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced.*

29. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service.*

30. ☐ *Rotate tong in high gear for 5 minutes while monitoring temperature of top and bottom bearing caps. If the bearing caps are hot to the touch (higher than approximately 50°C) replace the applicable bearings. Likewise if the tong is making unusual noises check for damaged bearings (see Maintenance Manual for all bearing locations).*

31. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*

32. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

33. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*

34. ☐ *Inspect load cell for damage or signs of stress. Check oil level in load cell and fill if necessary (refer to technical manual Section 7 or Section 8).*

35. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

36. ☐ *Perform a full functional test of the tong including, if applicable, backup components, lift cylinder, and float frame components. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

37. ☐ *Test safety door feature (if equipped). Begin rotating the tong at low speed, and open the tong door(s). If rotation does not immediately stop, this is an indication that the safety door mechanism is not operating correctly and the tong must be removed from service until the mechanism is repaired. Repeat the test while operating the tong in the opposite direction. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

38. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external unpainted surfaces (and chain slings) EXCEPT cylinder rods, jaw rollers, and rotary gear camming surfaces. Refer to manufacturer data sheets for proper application and safety information.*

Once all of the above maintenance checklist items have been satisfactorily completed the tool may be returned to service.

K. DAILY INSPECTION & MAINTENANCE CHECKLIST (POWER UNIT)

Farr recommends that the following inspections and maintenance procedures be performed before each use, and at least once per day when the equipment is in steady use, in the sequence in which they are listed. Rigorous inspection and maintenance, especially lubrication, is essential in order to ensure that your equipment always meets specifications, and to prevent catastrophic failures that can severely damage your equipment and cause worker injury.

If using a stand-alone power unit, perform the following inspection and maintenance procedures before each use, and at least once per day when the power unit is in steady use:

Do not perform any maintenance while the power unit is energized (electric) or if the engine is running (diesel). Ensure the electrical supply is locked out, or, if using a diesel power supply, ensure that the engine is locked out or the starting mechanism otherwise disabled.

DIESEL ONLY

1. ☐ *Check engine oil levels - add if necessary*
2. ☐ *Check diesel fuel tank - fill if necessary.*
3. ☐ *Visually inspect all fan belts.*
4. ☐ *Activate mechanical shut-off device - ensure that shut-off switch on engine is engaging when manual shut-off switch is actuated.*

ELECTRIC ONLY

1. ☐ *Visually inspect all electrical lines and visible connections. If your unit is NOT explosion proof, open the electrical enclosure and VISUALLY inspect contacts and connections for signs of corrosion or arcing. Do not open explosion-proof enclosures.*

NEVER PLACE HANDS INSIDE AN ELECTRICAL ENCLOSURE UNLESS YOU HAVE CONFIRMED THAT THE POWER HAS BEEN DISCONNECTED AND LOCKED OUT

2. ☐ *Visually inspect main electrical line between main power source and power unit.*

ALL UNITS

5. ☐ *Perform a visual inspection of all parts. Check to ensure there are no loose or missing fasteners.*
6. ☐ *Check hydraulic fluid level - ensure cold level is approximately half-way up the sight glass on the hydraulic fluid reservoir.*
7. ☐ *Perform a visual inspection to ensure there are no hydraulic fluid leaks - correct if necessary.*
8. ☐ *Check that the main supply and return lines on the hydraulic fluid reservoir are both fully open.*
9. ☐ *Apply grease to any grease fittings that your power unit may have. Apply grease to each fitting until grease is visibly displaced from bearing, or as recommended by your power unit manual.*
10. ☐ *Ensure supply and return connections at the power unit and at the equipment in use are fully made up.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

11. ☐ *Check hydraulic fluid filter back pressure (must be done while fluid is circulating). If needle on indicator gauge is in the red zone, the filter should be changed the next time the unit is shut down*

L. TUBULAR CONNECTION EQUIPMENT DE-COMMISSIONING PROCEDURE

Perform the following decommissioning procedures when removing tubular connection equipment from service, with the intent of short to long-term storage. These procedures are essential for ensuring proper protection of the equipment from environmental attack, and to aid in the quick turnaround when returning the equipment to service.

Store all o-rings, seals, packings, gaskets, etc. in strong moisture proof, airtight containers. Ensure that these items are not crushed, nicked, or otherwise damaged.

Do not perform any further actions or maintenance while the tong is connected to any hydraulic power supply. Farr recommends that all hydraulic lines are fully disconnected, and residual hydraulic pressure is bled off. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid.

DEPRESSURIZATION PROCEDURE IN PREPARATION FOR STORAGE:

1) *Rotate the tong so that the opening in the rotary gear faces the gear train (towards the rear of the tong). Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder (if equipped). If mounted in a frame, retract the float cylinders (if equipped).*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

1. ☐ *Perform an initial wash of the tool in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*
4. ☐ *Clean the exterior of the tool thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*
5. ☐ *Inspect all fasteners and fastener safety wires. Replace any missing fasteners - use Grade 8 bolts only. Re-torque all external fasteners to SAE specifications.*
6. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*
8. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to storage. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "Farr Blue" is paint number RAL.5005. Allow sufficient time for paint to dry before proceeding.*
9. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
10. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*
11. ☐ *Energize power unit.*
12. ☐ *Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

13. ☐ *Energize power unit. Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train.*

14. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

15. ☐ *Energize power unit, and rotate the tong for a final time, one minute in one direction, stop, and reverse the direction of rotation for another minute, this time ending with the rotary gear in the "open throat" position.*

16. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

17. ☐ *If you are using a frame-mounted tool, the tong must be lowered onto the backup in order to remove the risk of sudden and catastrophic movement when pressure is removed from the float cylinders. Cover the top of the backup with protective cloth to protect the paint on the backup. Place two wooden beams across the top of the tong, ensuring that the beams have a minimum size of 4" x 4" x the width of the tong. Cover the tops of the wooden beams with more protective cloth to prevent paint damage to the tong. When lowering the tong onto the beams, ensure that the beams come into flat contact with the bottom of the tong, away from bearing caps, brake bands, or other protrusions on the bottom of the tong. Ensure that the tong hanger chains are loose, but not dangling into contact with the hangers or top plate of the tong.*

DEPRESSURIZATION PROCEDURE FOR STORAGE:

1) *Rotate the tong to the "open throat" position.*
2) *Exercise each hydraulic cylinder several times - open the tong and backup doors (if equipped), retract and extend the remote backing pin ramp (if equipped), retract and extend the float cylinders. Leave all cylinders except for the door cylinders in their fully retracted position. The general idea is to have as little of the chrome cylinder rods exposed as possible.*
3) *De-energize the power unit.*
4) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
5) *Remove the hydraulic SUPPLY line from the equipment.*
6) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Connect a low-pressure air supply line (10 PSI or less) to the hydraulic supply line, and force a small amount of the remaining hydraulic fluid from the valve assembly - this will allow for thermal expansion of the hydraulic fluid if the equipment is stored or transported in high ambient temperatures. Failure to do this may result in damaged or destroyed seals in the equipment.*
8) *Disconnect the hydraulic RETURN line from the equipment.*
9) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

18. ☐ *If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

19. ☐ *Wipe all excess grease from outside of equipment. Replace the access door panel. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been degreased, wipe all external surfaces with clean water to remove residual solvent.*

20. ☐ *Farr recommends that chain slings be removed and stored separately. Rigid slings and other rigid suspension devices may remain in place.*

21. ☐ *Apply grease or heavy oil to all exposed cylinder rods.*

22. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces EXCEPT cylinder rods (including chain slings). Refer to manufacturer data sheets for proper application and safety information.*

DO NOT ALLOW ANTI-CORROSIVE AGENTS TO CONTACT CYLINDER RODS. CYLINDER ROD DAMAGE WILL OCCUR.

23. ☐ *Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*

24. ☐ *Wrap entire assembly in 100 gauge (1 mil) corrosion-inhibiting wrap, at least 3 layers thick. Attempt to ensure that the tool is well-sealed within the wrapping, including the bottom.*

If possible, store in a sealed, climate controlled environment. If isolated storage is not available, Farr recommends storing your wrapped equipment in a secure, out-of-the-way location, using silica gel desiccant to reduce the humidity within the wrapping. As a guideline, use 125 g. of desiccant for each cubic metre of space, or 3.5 g. per cubic foot.

CALCULATION OF REQUIRED DESICCANT

1) *Calculate the trapped air volume by measuring the outside dimensions of the tool to be stored, and treat that as the volume to be stored. For example, the external dimensions of a KT20000 20" power tong are 80.25" x 50.5" x 28", which calculates to an approximate volume of 113500 in^3, or 66 ft^3 (1.87 m^3).*
2) *Multiply the calculated air volume, in cubic feet, by the recommended amount of desiccant per cubic foot. Carrying forth the example used in the previous step, the required desiccant charge would be 3.5 g. x 66 ft^3, equaling 231 g. Several manufacturers offer silica gel desiccant in packaged quantities of 125 grams per bag, so two packages of desiccant would be required. Please keep in mind that this is a guideline only - more or less desiccant may be required in extreme environmental conditions.*

For best corrosion resistance the equipment should be removed from storage and exercised on a regular basis, depending on the storage environment. Farr recommends that for equipment stored in a salt-water maritime or exposed dusty environment, repeat steps 9 through 24 monthly. For equipment stored in isolated storage in a non-maritime environment, repeat steps 9 through 24 quarterly. Replace desiccant packs at this time - depleted desiccant packs may be treated as regular dunnage.

M. TUBULAR CONNECTION EQUIPMENT RE-COMMISSIONING PROCEDURE

Perform the following recommissioning procedures when removing tubular connection equipment from short or long-term storage back into regular service. These procedures are essential for ensuring proper equipment preparation and operation. The following procedures also assume that the decommissioning and storage procedures recommended by Farr have been strictly observed.

1. ☐ *Remove all protective plastic wrapping. If there are desiccant packs with the assembly, they may be disposed of with the regular garbage.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Wipe excess grease or heavy oil from exposed cylinder rods.*
4. ☐ *If applicable, re-connect chain sling to lifting lugs. Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. If your company requires yearly certification of lifting equipment, ensure that the most recent test date falls within the past year. Perform recertification if necessary.*
5. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
6. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

7. ☐ *Energize power unit.*
8. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*
9. ☐ *Perform a thorough inspection of pressurized hydraulic lines and fittings. Any leaking hydraulic fluid lines or fittings must be replaced before the equipment is returned to service.*
10. ☐ *Perform a thorough inspection of all seals. Any seal that is leaking or "weeping" must be replaced before the equipment is returned to service.*
11. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service. Finish this step with the rotary gear opening facing the gear train. De-energize the power unit.*
12. ☐ *Inspect all flexible hydraulic lines for signs of wear, blistering, or any other signs of potential failure - replace if signs of potential failure are identified.*
13. ☐ *Inspect the gear train housing. If the amount of grease is inadequate, liberally grease the gear train through the access panel, and through the opening in the rotary gear.*
14. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands. Ensure that all grease is wiped from brake band linings and the parts of the cage plates that come into contact with the brake band linings*
15. ☐ *Re-install access panel. Install a set of pre-inspected jaws that are the correct size for the pipe or casing being run.*
16. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*
17. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*
18. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*
19. ☐ *Re-energize power unit.*

20. ☐ *Perform a full functional test of the equipment including, if applicable, backup components and float frame components. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

21. ☐ *If using a frame-mounted tong and backup system, raise the tong off the beams that it is resting upon. Remove the beams and protective cloths - inspect the paint on top of the backup and the bottom of the tong to ensure it has not been damaged by the beam.*

22. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

23. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

24. ☐ *When all of the previous steps are completed, you may return your re-commissioned equipment to service.*

Adequate maintenance and proper fluid selection is essential for minimizing hydraulic-related failures. All troubleshooting must be performed by a technician trained in hydraulic systems, and familiar with the equipment design, assembly and operation.

The following troubleshooting instructions are intended to be guidelines only. Any faults not solved through the use of this guide should be referred to our engineering department for their evaluation and recommendations.

A. TONG WILL NOT DEVELOP SUFFICIENT TORQUE

1. *Malfunctioning relief valve on tong hydraulic circuit.*
   a. *POSSIBLE PROBLEM: Relief pressure set too low.*

      SOLUTION: Increase setting. To check, block the oil line beyond the relief valve and determine pressure with a gauge.

   b. *POSSIBLE PROBLEM: Relief valve is stuck.*

      SOLUTION: Check for contamination of oil that may inhibit the way the valve actuates. Remove valve and clean, ensuring that the valve spring operates smoothly.

   c. *POSSIBLE PROBLEM: Relief valve is leaking.*

      SOLUTION: Check valve seat for scouring. Check oil seals. Check for particles stuck under the valve system.

2. *POSSIBLE PROBLEM: Directional valve is leaking.*

   SOLUTION: Check directional valve. Neutral position should return fluid directly to the reservoir. Replace or repair valve to ensure correct operation.

3. *POSSIBLE PROBLEM: Power unit is not producing adequate pressure.*

   SOLUTION: Troubleshoot power unit (see user's manual for your particular unit).

4. *POSSIBLE PROBLEM: Poor hydraulic pressure at the tong despite adequate pressure at the power unit, or excessive back pressure in the return line.*

   SOLUTION: Restrictions exist in line between power unit and tong. Inspect integrity of self-sealing couplings to ensure they are allowing full fluid flow. Check to ensure no other restrictions exist (contaminated catch screens or filters, for example).

5. *POSSIBLE PROBLEM: Fluid viscosity is not appropriate (too high or too low).*

   SOLUTION: Ensure hydraulic fluid being used is the viscosity recommended by McCoy Drilling & Completions. Power unit pump may not prime if fluid is too heavy, and the hydraulic system will overheat if fluid is too light. Replace with proper viscosity fluid.

   SOLUTION: Hydraulic fluid viscosity is affected by environmental conditions. Ensure the fluid being used is suitable for high or low temperatures. Replace with proper viscosity fluid for the operating conditions if necessary.

6. *POSSIBLE PROBLEM: Worn or damaged tong motor causing slippage.*

   SOLUTION: Replace or repair worn or damaged motor.

7. *POSSIBLE PROBLEM: Damaged bearings or gears causing excessive drag.*

   SOLUTION: Replace or repair worn or damaged gears or bearings.

8. *POSSIBLE PROBLEM: Jaws slipping on pipe.*

   SOLUTION: Ensure jaw dies are not worn to the point that they cannot grip. Ensure the correct sized jaws are in use.

9. *POSSIBLE PROBLEM: Torque gauge is indicating incorrectly*

   SOLUTION: Incorrect gauge is being used. Ensure gauge is the proper range, and has been properly calibrated for the arm length of the equipment in use.

   SOLUTION: Gauge has been damaged. Check gauge operation and calibration on independent system.

10. *POSSIBLE PROBLEM: Load cell is measuring incorrectly.*

    SOLUTION: Incorrect load cell is being used.

    SOLUTION: Air is trapped in torque measuring circuit (load cell, hydraulic line, or gauge. Refer to torque measurement troubleshooting in Section 6 of this manual.

    SOLUTION: Load cell has been damaged. Replace load cell, or return to McCoy for repair and re-calibration.

TONG WILL NOT DEVELOP SUFFICIENT TORQUE Cont'd:

11. *POSSIBLE PROBLEM: Incorrect motor speed selected.*
    SOLUTION: Maximum torque can only be developed when motor is in the lowest speed. Ensure motor is in low speed.

12. *POSSIBLE PROBLEM: Incorrect tong gear selected.*
    SOLUTION: Maximum torque can only be developed when tong is in low gear. Ensure tong is in low gear.

MCCOY DRILLING & COMPLETIONS GUARANTEES CALIBRATION OF A LOAD CELL/TORQUE GAUGE ASSEMBLY FOR A PERIOD OF ONE YEAR. MCCOY SUGGESTS THAT THE LOAD CELL/ TORQUE GAUGE ASSEMBLY BE RETURNED TO THE FACTORY FOR RE-CALIBRATION ON A YEARLY BASIS.

B. FAILURE OF JAWS TO GRIP PIPE

1. *POSSIBLE PROBLEM: Dies have become too dull to provide adequate grip.*
   SOLUTION: Replace dies.

2. *POSSIBLE PROBLEM: Incorrect jaws are being used.*
   SOLUTION: Double-check jaw size to ensure they are rated for the diameter of pipe or casing being run.

3. *POSSIBLE PROBLEM: Incorrect dies are being used*
   SOLUTION: Ensure dies loaded in the jaws are appropriate for the type of pipe or casing being run.

4. *POSSIBLE PROBLEM: Brake band(s) is (are) insufficiently adjusted, not allowing jaws to cam properly.*
   SOLUTION: Adjust brake bands to give proper resistance to cage plates.

5. *POSSIBLE PROBLEM: Jaw roller broken or worn.*
   SOLUTION: Remove jaw assembly and inspect. Replace rollers that are visibly "flat-spotted" or otherwise damaged.

C. TONG RUNNING TOO SLOWLY

1. *POSSIBLE PROBLEM: Obstruction in tong hydraulic circuit preventing adequate flow.*
   SOLUTION: Inspect self-sealing couplings to ensure they are properly engaged.
   SOLUTION: The main hydraulic lines (supply and discharge) to the tong are obstructed. Remove and clean if required.

2. *POSSIBLE PROBLEM: Power unit is not producing adequate flow or pressure.*
   SOLUTION: Troubleshoot power unit (see user's manual for your particular unit).

3. *POSSIBLE PROBLEM: Tong motor is excessively worn and is leaking hydraulic fluid past the vanes.*
   SOLUTION: Replace motor, or rebuild as per Section 7 of this manual.

4. *POSSIBLE PROBLEM: Bearings in gear train and rotary section are excessively worn.*
   SOLUTION: Overhaul tong. See Section 3 of this manual for tong overhaul procedures.

5. *POSSIBLE PROBLEM: Shifter has malfunctioned and the tong is not shifting to high gear.*
   SOLUTION: Inspect and repair shift mechanism as necessary.

6. *POSSIBLE PROBLEM: Two-speed hydraulic motor (if equipped) is not set to correct speed.*
   SOLUTION: Check motor, and set to the correct speed if required.

7. *POSSIBLE PROBLEM: Safety door system is not properly adjusted - hydraulic fluid leak past Deltrol valve.*
   SOLUTION: Check and adjust safety door system.

8. *POSSIBLE PROBLEM: Hydraulic fluid viscosity too high.*
   SOLUTION: Ensure hydraulic fluid meets McCoy Drilling & Completions specifications.
   SOLUTION: Ensure hydraulic fluid is appropriate for climatic conditions, especially during cold-weather operation..

9. *POSSIBLE PROBLEM: By-pass valve not functioning.*
   SOLUTION: Check and repair.

D. FAILURE OR DIFFICULTY OF TONG TO SHIFT

1. *POSSIBLE PROBLEM: Bent or broken shifter handle.*
   SOLUTION: Replace shifter handle.

2. *POSSIBLE PROBLEM: Bent or broken shifter yoke.*
   SOLUTION: Inspect and replace shifter yoke.

3. *POSSIBLE PROBLEM: "Frozen" or hard-to-move shifter handle.*
   SOLUTION: Grease shifter shaft.

4. *POSSIBLE PROBLEM: Bent or broken shifter shaft.*
   SOLUTION: Replace.

5. *POSSIBLE PROBLEM: Locking nuts on shifting shaft have loosened and position of yoke has changed.*
   SOLUTION: Reposition yoke and re-tighten locking nuts.

6. *POSSIBLE PROBLEM: Shifting yoke has come loose from shifting shaft*
   SOLUTION: Inspect yoke and inspect for damage. If free of damage, replace on shaft and tighten locking nuts.

7. *POSSIBLE PROBLEM: Tong pops out of gear*
   SOLUTION: Ensure that detent ball & spring assembly has been correctly set.

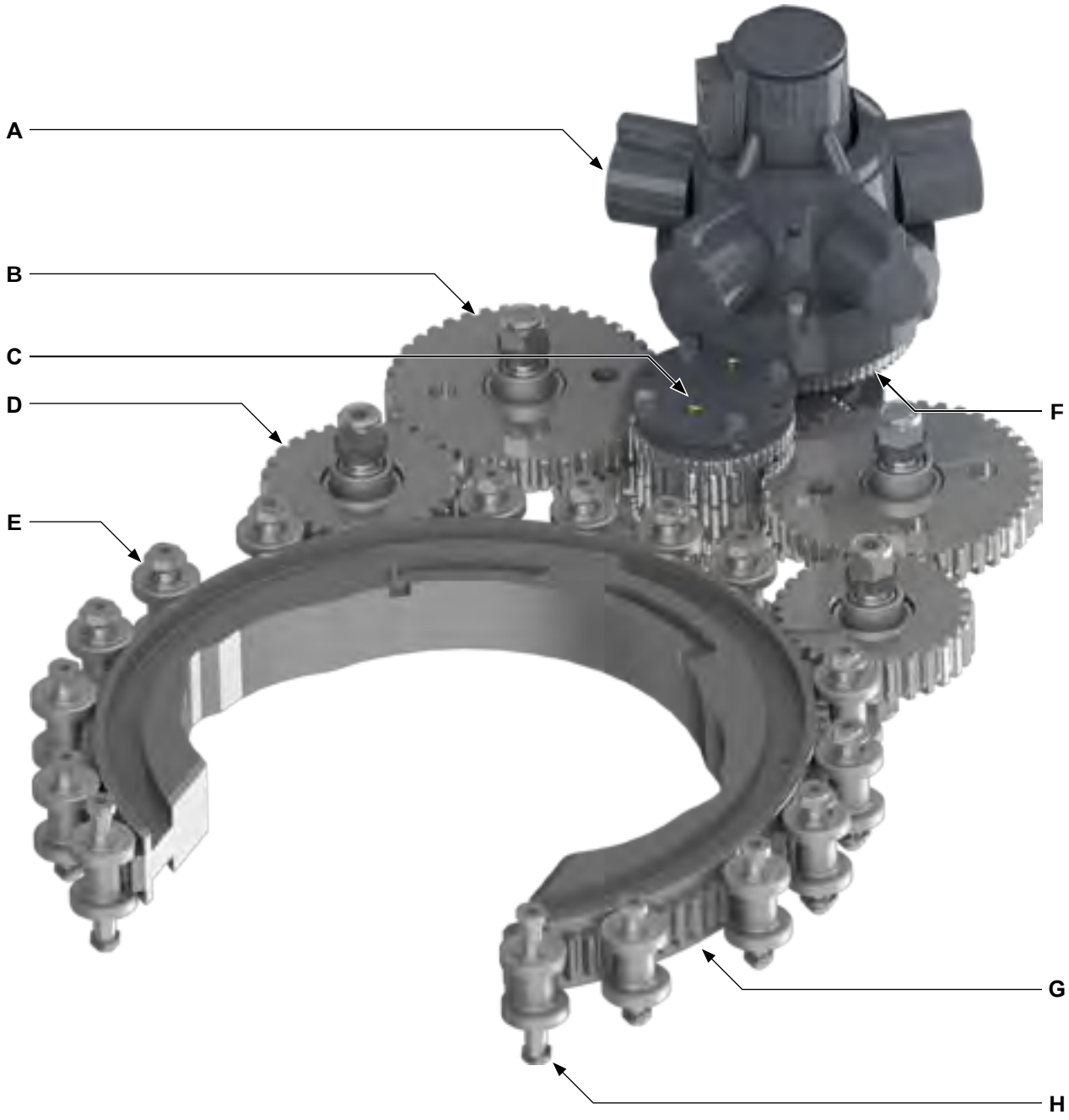
H. GENERAL COMMENTS

The following factors generally contribute to poor hydraulic operation and premature wear of equipment:

1. *Contaminated hydraulic fluid due to overuse, overheating, or inadequate fluid filtration.*
2. *Unsuitable hydraulic fluid, especially in extreme climatic conditions.*
3. *Defective packing or seals in components of the hydraulic system.*
4. *Poor or incomplete hydraulic system training. Users must be fully qualified to operate the equipment, and have complete understanding of the hydraulic system.*

If your hydraulic troubleshooting procedures involve flow and pressure tests at the power unit, McCoy Completions & Drilling recommends construction of a test rig that can easily be connected to the main suction and discharge ports of the power unit.

Assemblies and Parts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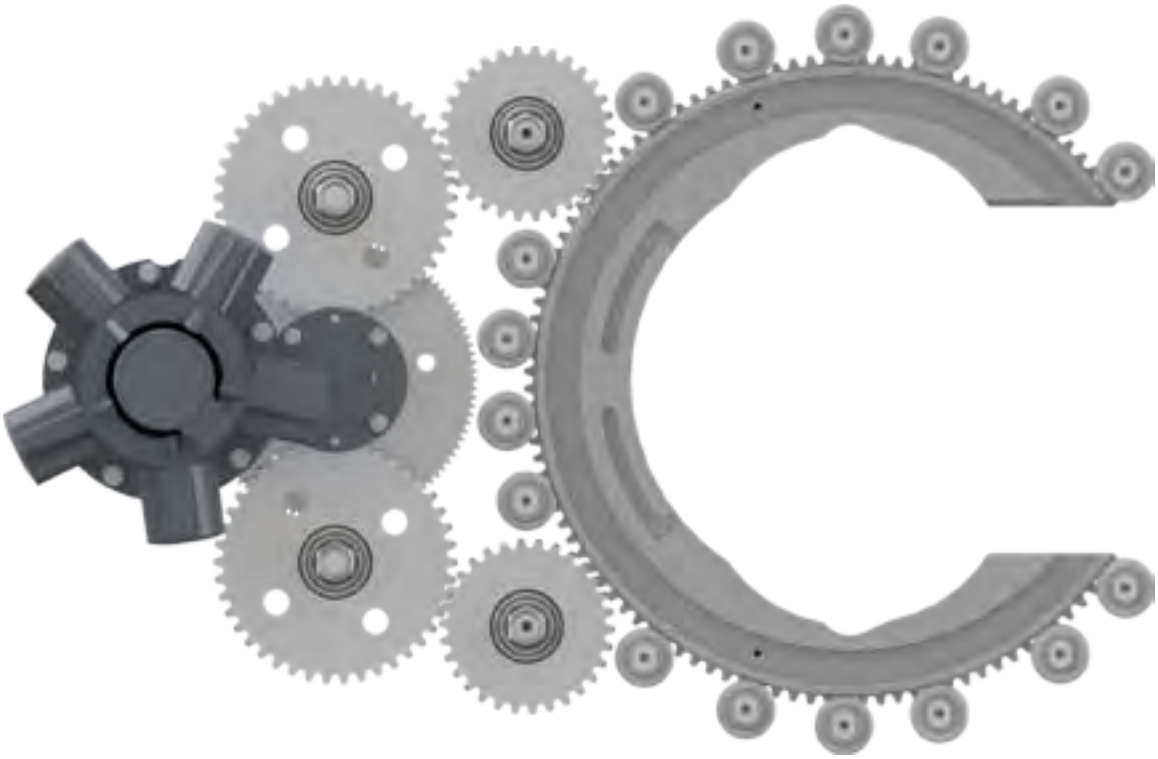
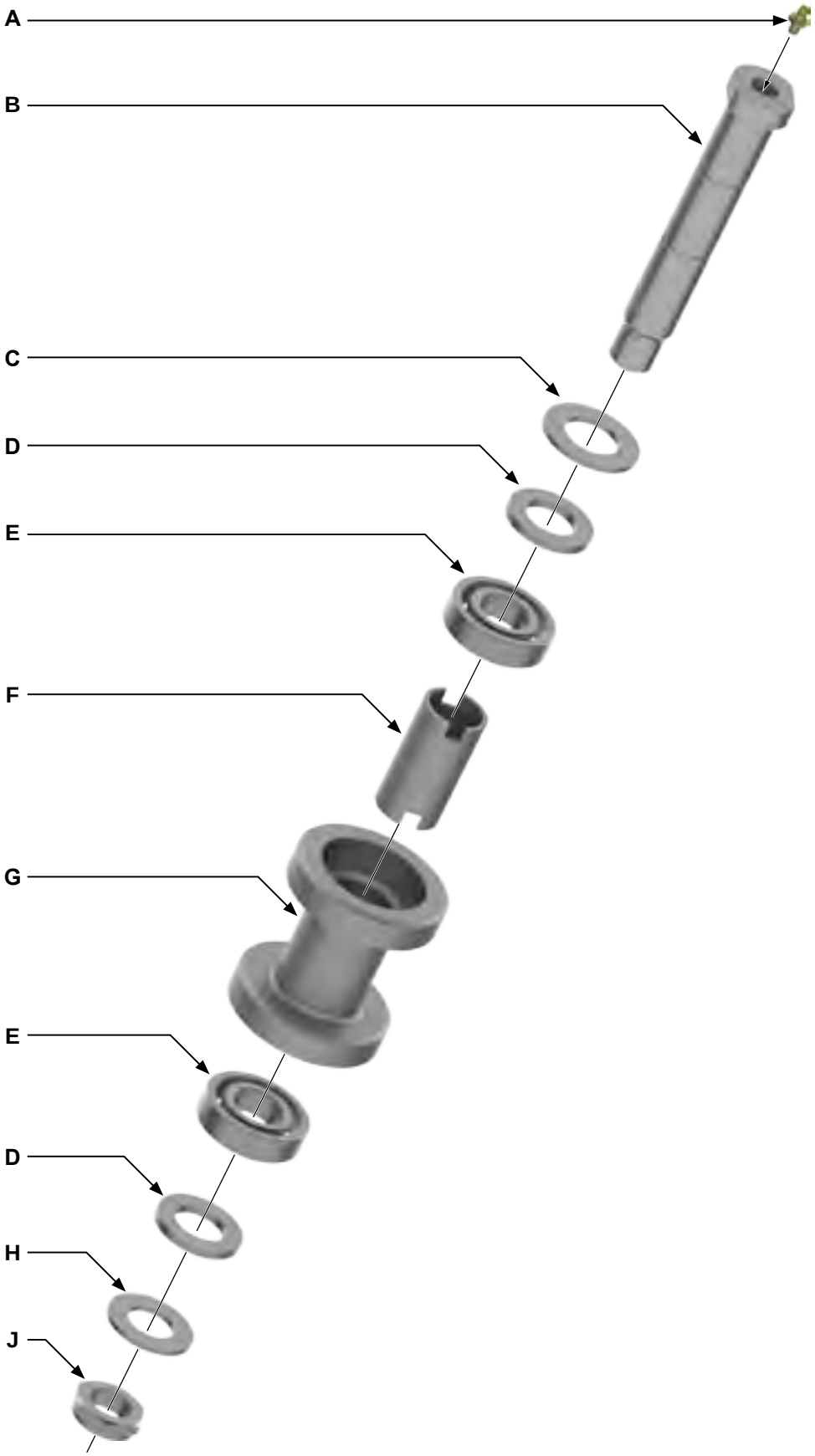


Item	Type	Description	Qty	Part Number
A	Part	Staffa HMB080/S/S03/70 Hydraulic Motor	1	87-0210B
	Part	Rineer GA125-A2-PC-082-31-0 Hydraulic Motor (Optional)	1	87-0150
B	Assembly	Pinion Idler Assembly (Pp. 7.10-7.11)	2	
C	Assembly	Pinion Gear Assembly (Pp 7.12 - 7.13)	1	
D	Assembly	Rotary Idler Assembly (Pp 7.8 - 7.9)	2	
E	Assembly	Support Roller Assembly (Pp. 7.4 - 7.5)	14	
F	Assembly	Clutch Assembly (Pp. 7.14 - 7.15)	1	
G	Part	Rotary Gear	1	1037-D-46
H	Assembly	Door Pivot Roller Assembly (Pp. 7.4 - 7.5)	2	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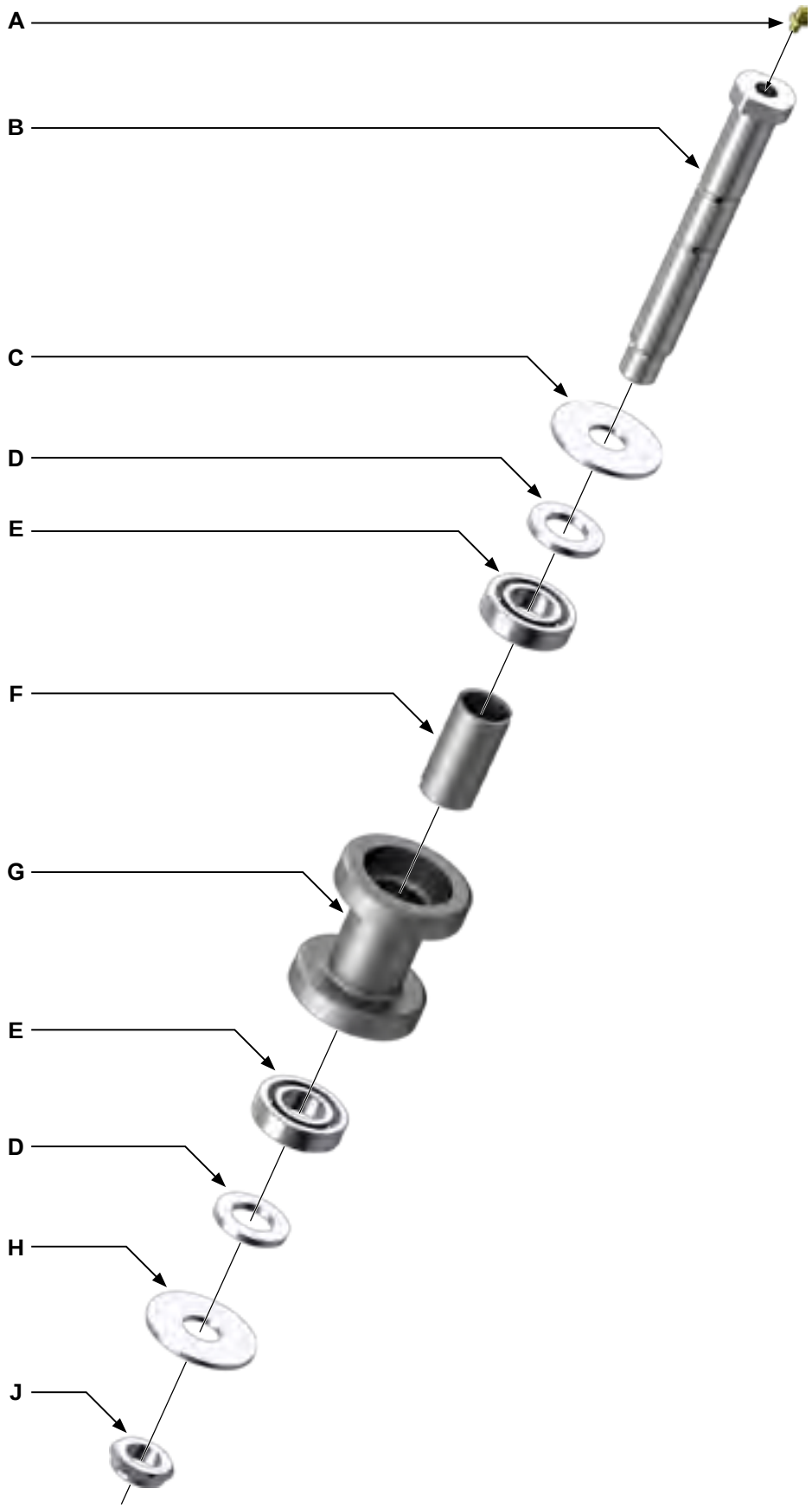
Item	Type	Description	Qty	Part Number
A	Part	1/4" UNF Straight Grease Fitting	1	02-0097
B	Part	Support Roller Shaft	1	101-3939
C	Part	1-1/8" Plain Flat Washer	1	09-5041
D	Part	Bearing Spacer	2	101-3871
E	Part	Support Roller Bearing	2	02-0094
F	Part	Support Roller Spacer	1	1037-C-134
G	Part	Support Roller	1	1037-135
H	Part	1" Narrow Flat Washer	1	09-5026
J	Part	1" UNS Thin Nylock Nut	1	09-5627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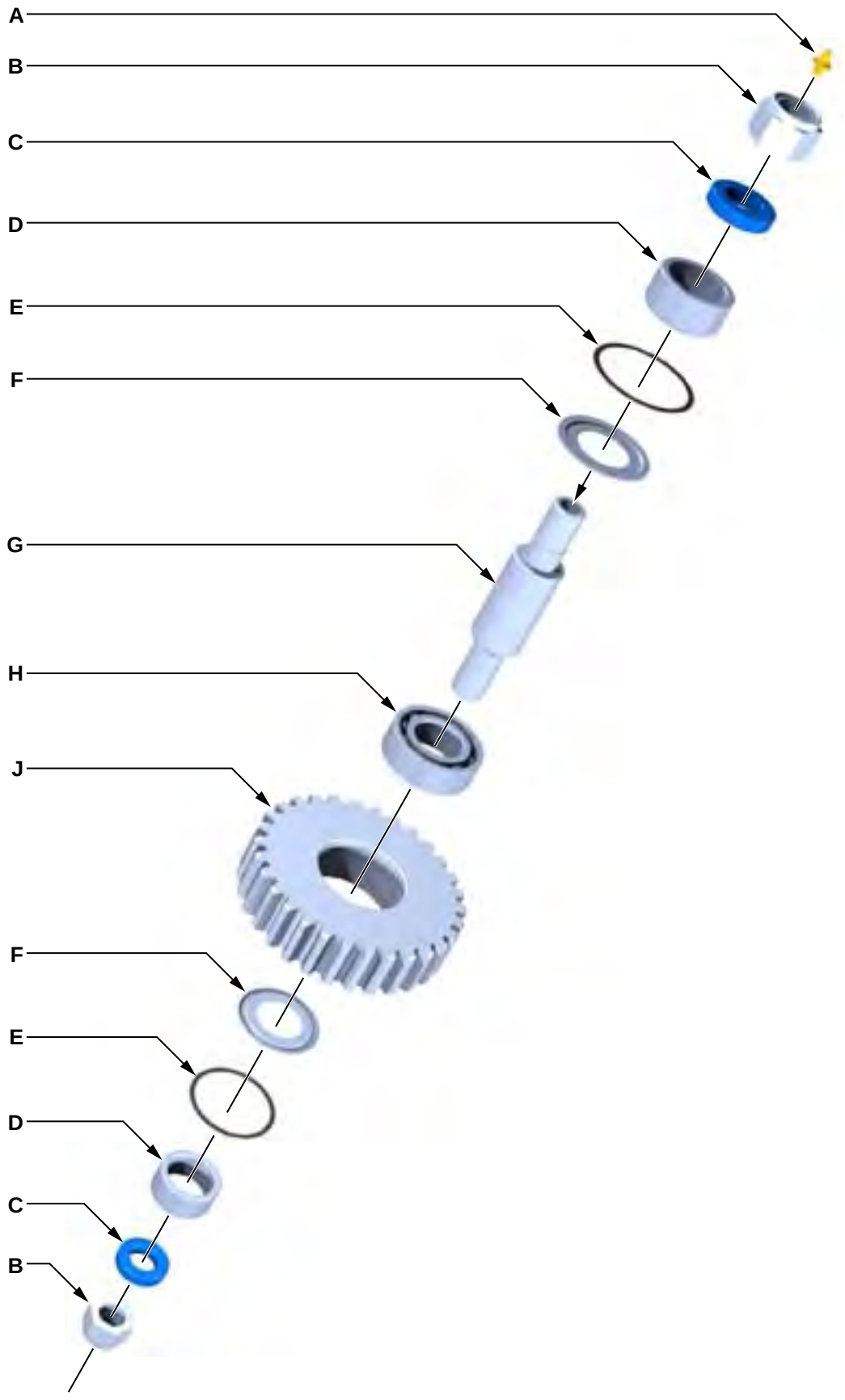
Item	Type	Description	Qty	Part Number
A	Part	1/4" UNF Straight Grease Fitting	1	02-0097
B	Part	Support Roller Shaft	1	101-3940
C	Part	1-1/8" Flat Washer	1	09-5041
D	Part	Bearing Spacer	2	101-3871
E	Part	Support Roller Bearing	2	02-0094
F	Part	Support Roller Spacer	1	1037-C-134
G	Part	Support Roller	1	1037-135
H	Part	1" Wide Flat Washer	1	09-
J	Part	1" UNS Thin Nylock Nut	1	09-5627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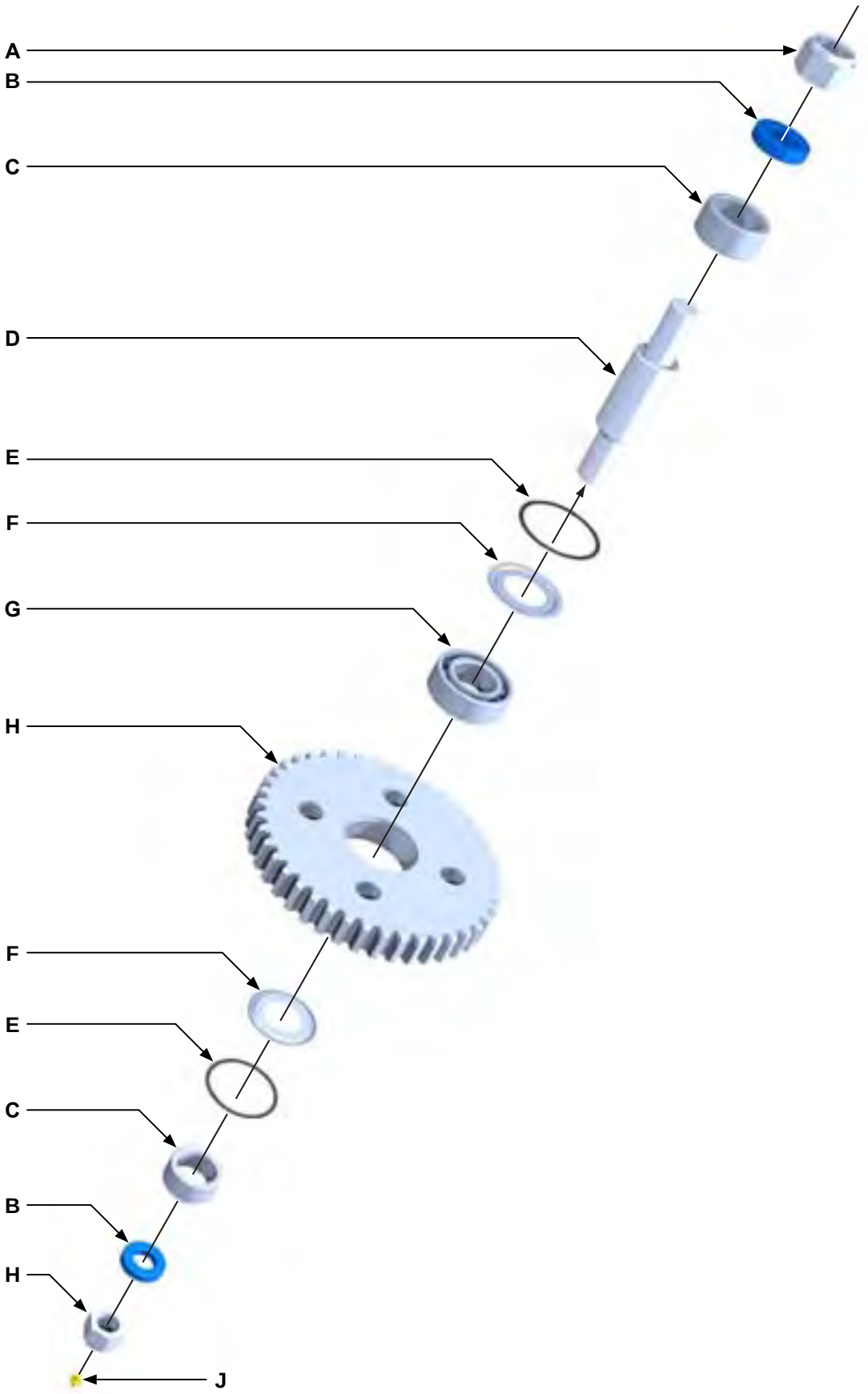
Item	Type	Description	Qty	Part Number
A	Part	1/8" NPT Grease Fitting	1	02-0005
B	Part	1-1/2" UNF Nylock Nut	2	09-5740
C	Part	Idler Pad	2	997-D20-125
D	Part	Idler Spacer	2	1050-D5-121
E	Part	Retainer Clip	2	02-0009
F	Part	Bearing Seal	2	02-0010
G	Part	Rotary Idler Shaft	1	1050-D5-117
H	Part	Cylindrical Roller Bearing	1	02-0011
J	Part	Rotary Idler Gear	1	1037-D59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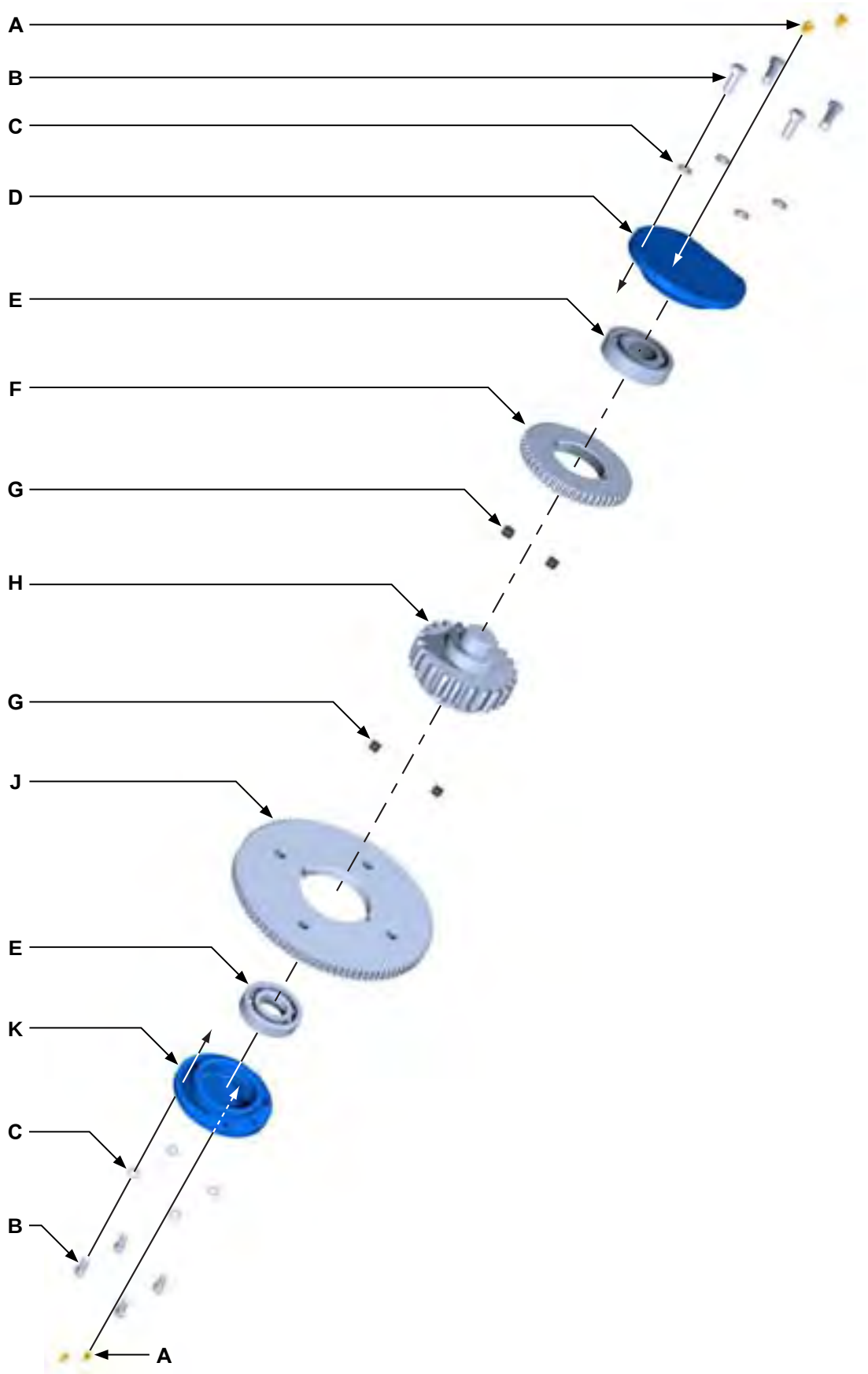
Item	Type	Description	Qty	Part Number
A	Part	1-1/2" UNF Nylock Nut	2	09-5740
B	Part	Idler Pad	2	997-D20-125
C	Part	Idler Spacer	2	1050-D5-121
D	Part	Pinion Idler Shaft	1	1050-D5-117
E	Part	Retainer Clip	2	02-0009
F	Part	Bearing Seal	2	02-0010
G	Part	Cylindrical Roller Bearing	1	02-0011
H	Part	Grease Fitting	1	02-0005
J	Part	Pinion Idler Gear	1	1037-D-1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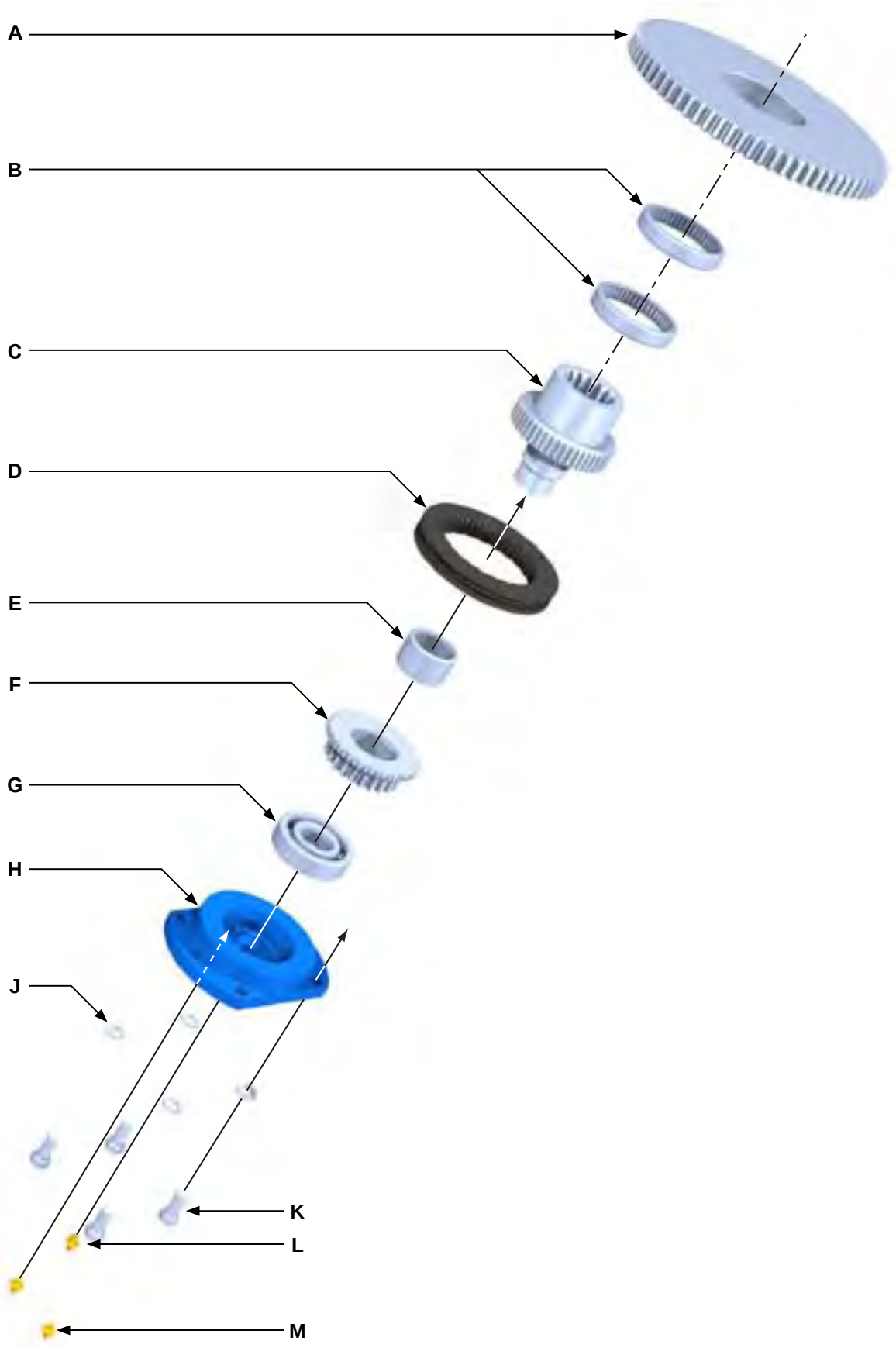
Item	Type	Description	Qty	Part Number
A	Part	1/8" NPT x 90° Grease Fitting	4	02-0093
B	Part	5/8" NC x 1-1/4" Hex Bolts	8	09-1228
C	Part	5/8" Lock Washers	8	09-5114
D	Part	Top Pinion Bearing Cap	1	1037-C-10
E	Part	Pinion Bearing	2	02-0106
F	Part	High Pinion Gear	1	1037-D-12
G	Part	Gear Key	4	1037-D-15A
H	Part	Pinion Gear	1	1037-D-15
J	Part	Bottom Pinion Bearing Cap	1	1037-C-33
K	Part	Low Pinion Gear	1	1037-D-32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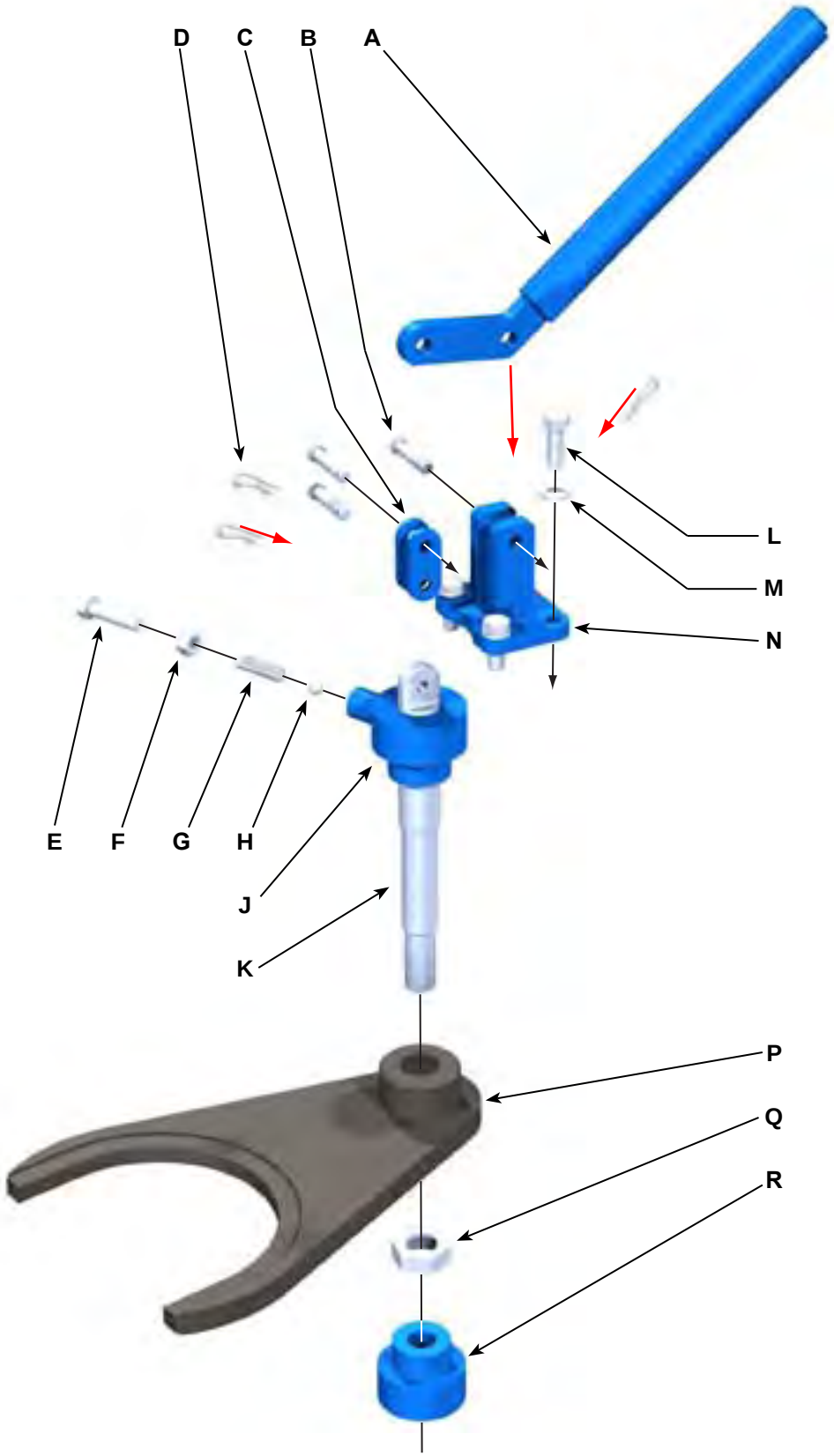
Item	Type	Description	Qty	Part Number
A	Part	High Clutch Gear	1	1037-D-41
B	Part	Top Clutch Bearing	2	02-0103
C	Part	Splined Clutch Shaft	1	1037-D-38
D	Part	Shifting Collar	1	1037-D-34
E	Part	Clutch Bearing	1	02-0104
F	Part	Low Clutch Gear	1	1037-D-40
G	Part	Bottom Clutch Bearing	1	02-0105
H	Part	Clutch Bearing Cap	1	1037-C-17
J	Part	5/8" Lock Washers	4	09-5114
K	Part	5/8" NC x 1-1/2" Hex Bolts	4	09-1230
L	Part	1/8" NPT Grease Fitting	1	02-0005
M	Part	1/8" NPT x 90° Grease Fitting	2	02-0093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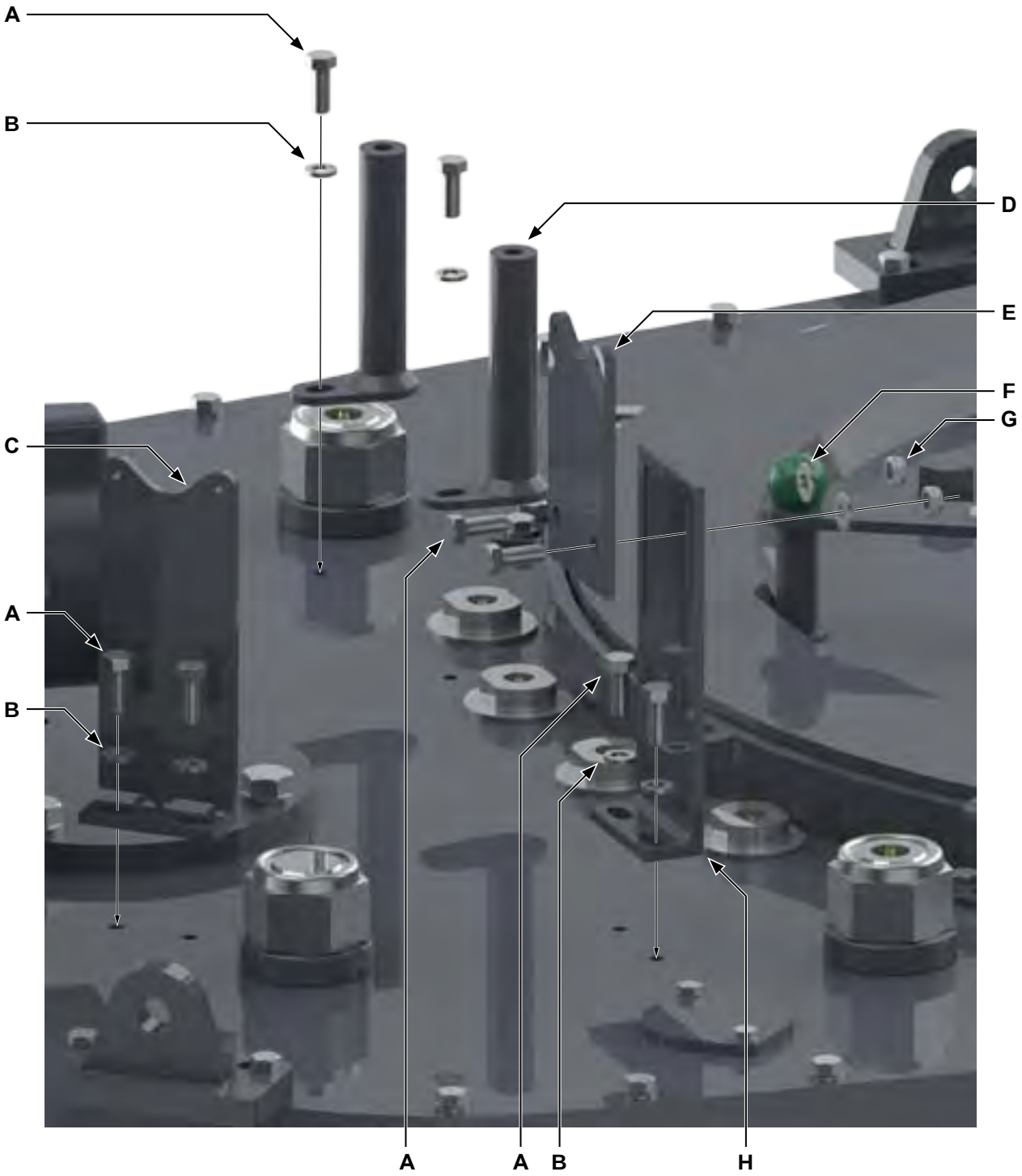
Item	Type	Description	Qty	Part Number
A	Part	Shifting Lever Weldment	1	1037-D-20B
B	Part	5/16" x 1-1/2" Clevis Pin	3	09-0256
C	Part	Shifting Link	2	02-0120
D	Part	0.093" x 1-1/8" Hitch Pin	3	
E	Part	3/8" NC x 1-1/2" Hex Bolt	1	09-1050
F	Part	3/8" NC Hex Nut	1	09-5806
G	Part	Detent Spring	1	997-0-64
H	Part	Detent Ball	1	02-0018
J	Part	Shifting Shaft Bushing Weldment	1	1037-C-21
K	Part	Shifting Shaft	1	1037-C-20A
L	Part	3/8" NC x 1" Hex Bolt	4	09-1170
M	Part	3/8" Lock Washer	4	09-5106
N	Part	Shifter Lug Weldment	1	101-0016
P	Part	Shifting Fork	1	1037-D-27
Q	Part	7/8" UNF Hex Jam Nut	1	09-1489
R	Part	Bottom Bushing	1	1037-C-21B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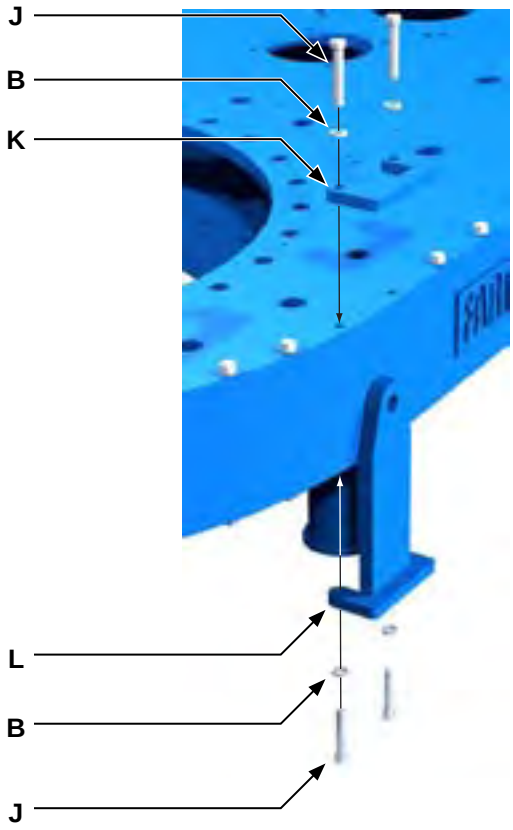
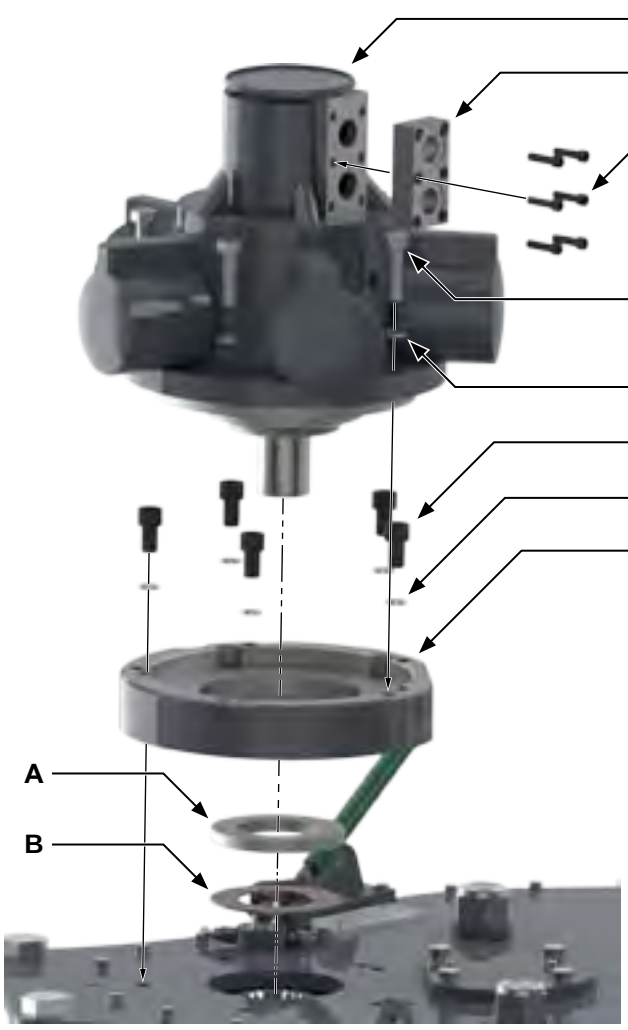
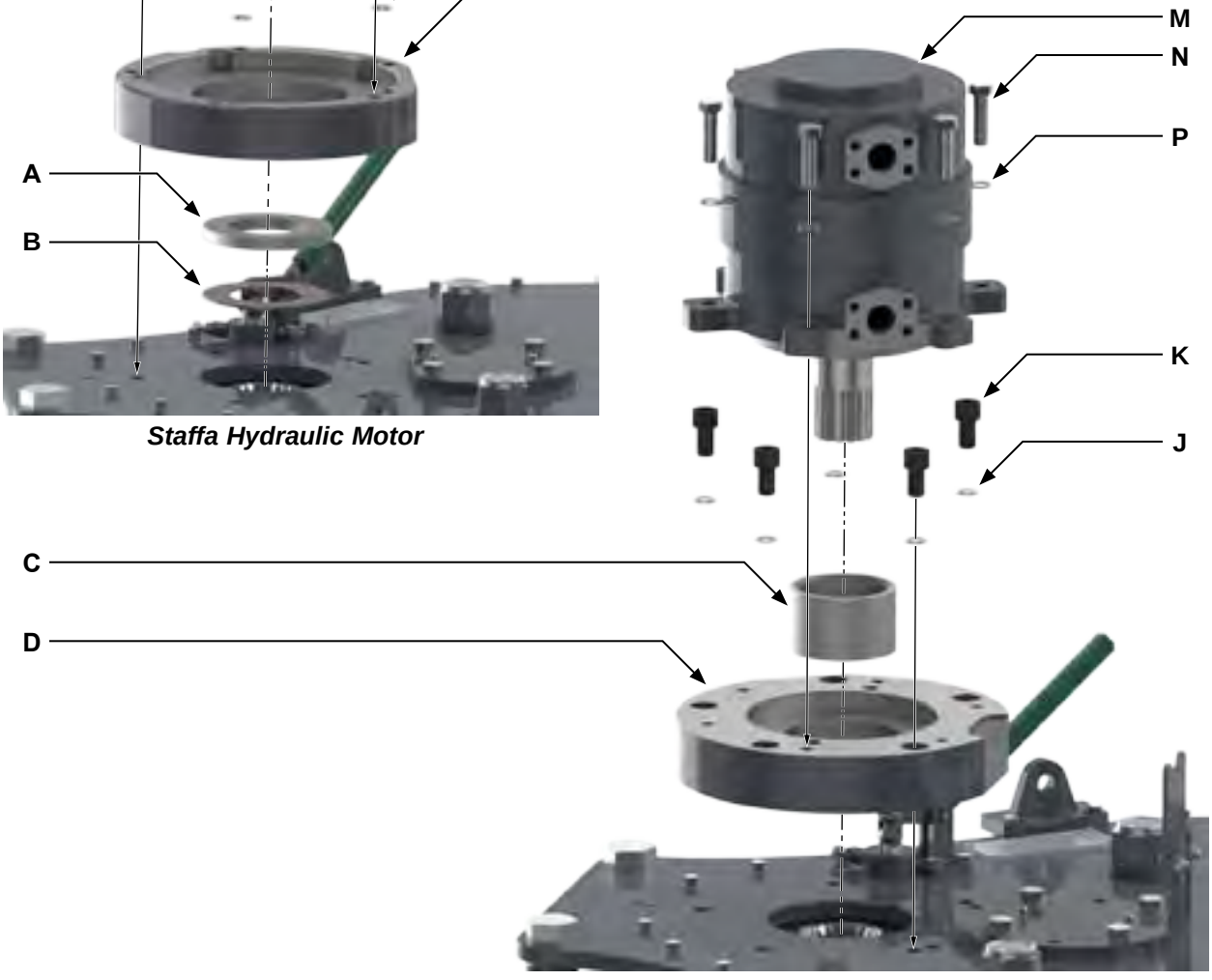


Item	Type	Description	Qty	Part Number
A	Part	3/8" NC x 1" Hex Bolt	8	09-1170
B	Part	3/8" Lock Washer	22	09-5106
C	Weldment	Hydraulic Discharge Line Support	1	101-2404
D	Weldment	Hydraulic Valve Support Post Weldment	2	101-1442
E	Part	Adjustable Inlet Line Support Plate	1	101-0022
F	Part	3/8" Narrow Flat Washer	2	
G	Part	3/8" Thin Nylock Nut	2	
H	Weldment	Hydraulic Inlet Line Support	1	101-1138
J	Part	3/8" NC x 2" Hex Bolt	16	
K	Part	Hanger Plate	4	101-4006
L	Part	Hanger Weldment	4	101-3985

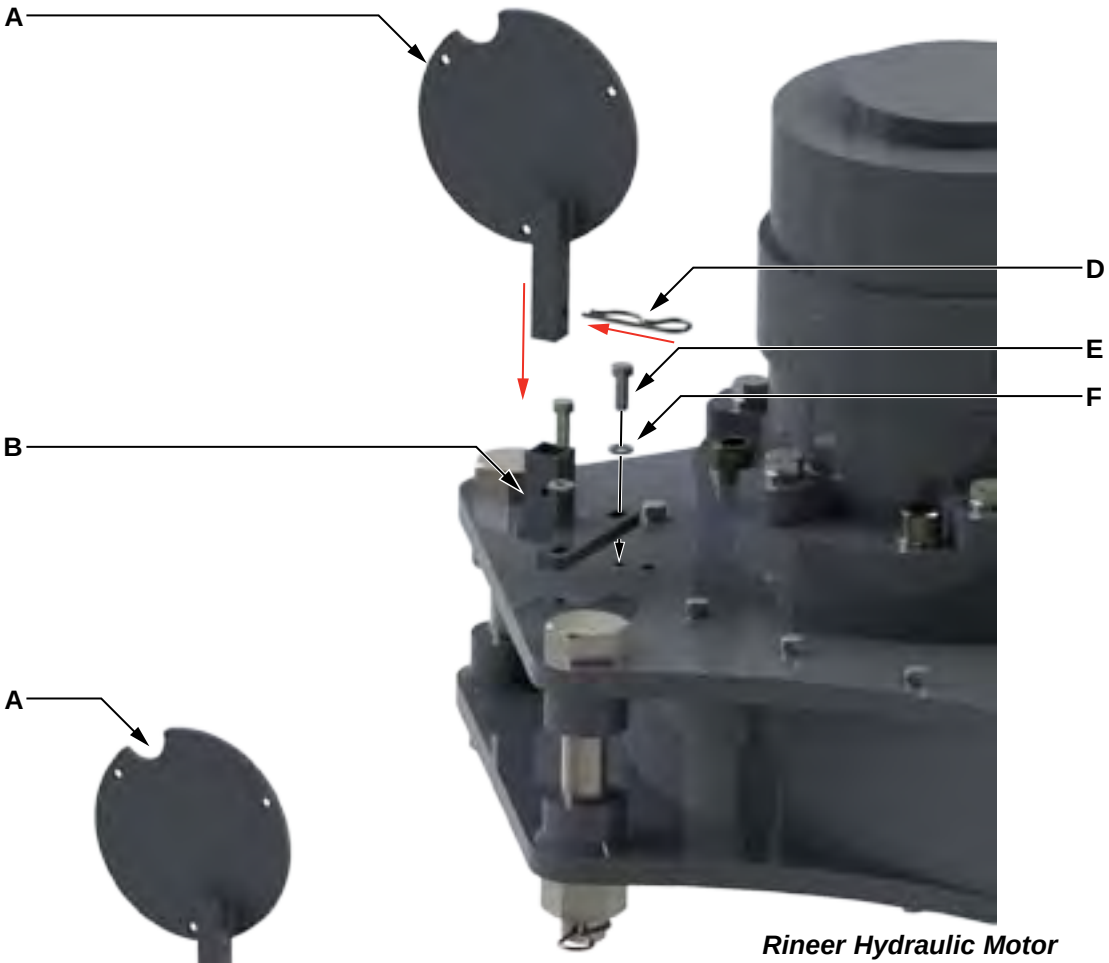


Staffa Hydraulic Motor

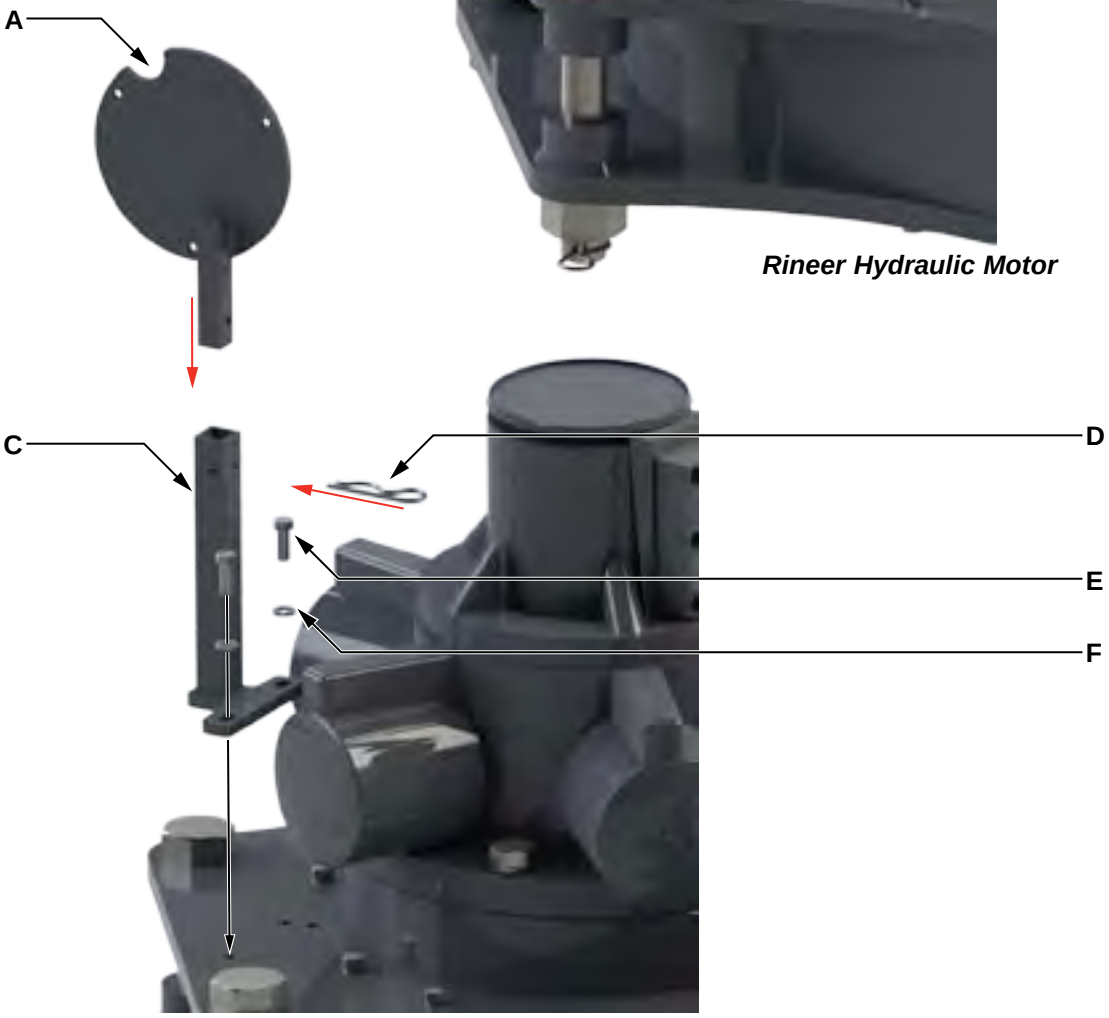


Rineer Hydraulic Motor

Item	Type	Description	Qty	Part Number
A	Part	Upper Motor Spacer	1	1037-D-38S
B	Part	Thrust Washer	1	101-3289
C	Part	Top Clutch Shaft Spacer	1	1037-42
D	Part	Motor Mount (Rineer)	1	1426-7
E	Part	Staffa Hydraulic Motor	1	87-0210B
F	Part	Staffa Manifold Block	1	87-0209
G	Part	3/8" UNC x 1-1/2" Hex Socket Head Cap Screw	6	09-2051
H	Part	3/4" UNC x 2-1/2" Hex Bolt	5	09-1296
J	Part	3/4" Helical Spring Lock Washer	15	09-5118
K	Part	3/4" UNC x 1-1/4" Hex Socket Head Cap Screw	10	09-2288
L	Part	Motor Mount (Staffa)	1	1037-D-7
M	Part	Rineer Hydraulic Motor	1	87-0150
N	Part	5/8" UNC x 2-1/4" Hex Bolt	6	09-1235
P	Part	5/8" Helical Spring Lock Washer	6	09-5114

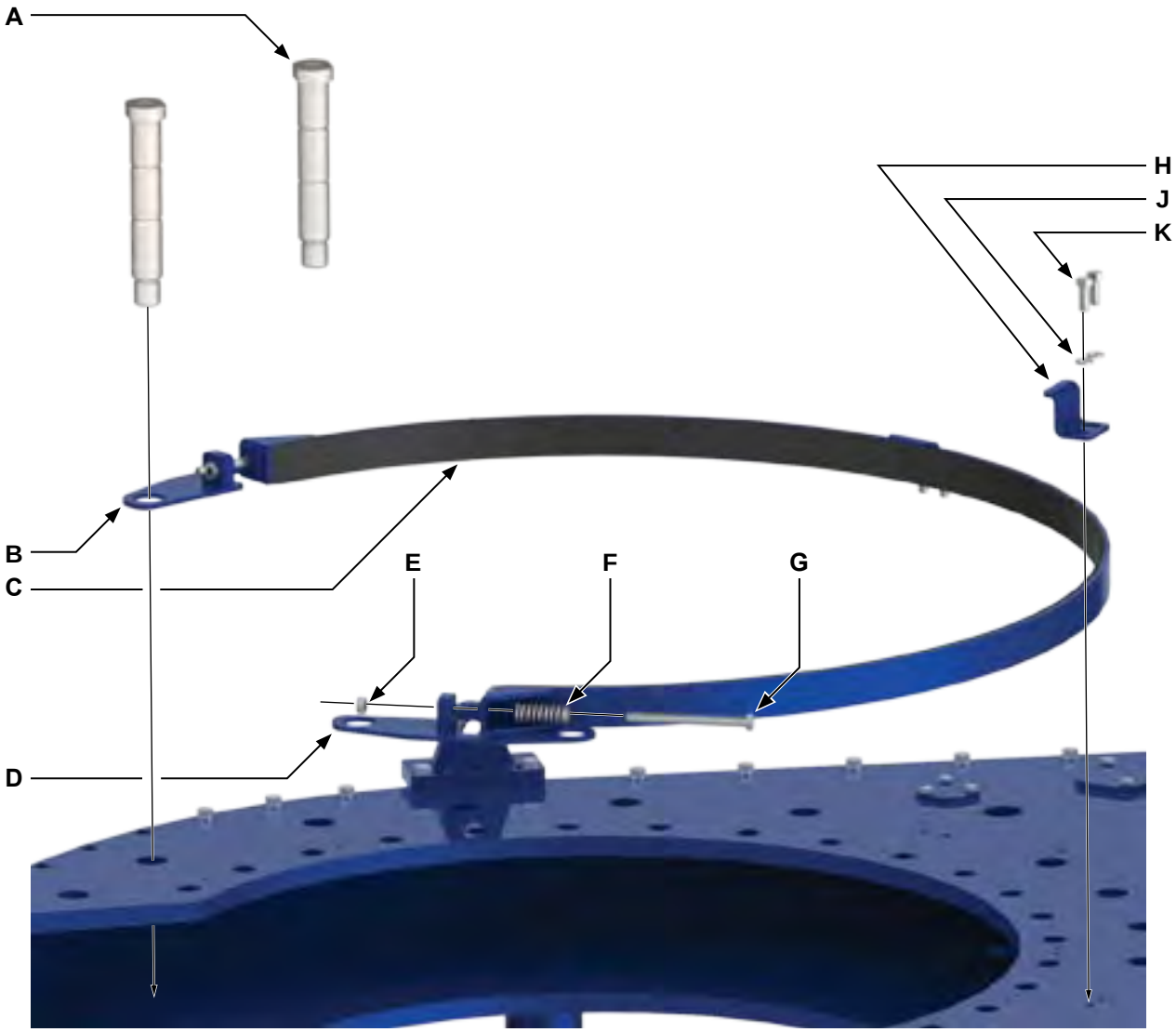


Rineer Hydraulic Motor



Staffa Hydraulic Motor

Item	Type	Description	Qty	Part Number
A	Weldment	Torque Gauge Mount	1	1500-09-03A
B	Weldment	Torque Gauge Mount Holder (Rineer Motor)	1	101-0480
C	Weldment	Torque Gauge Mount Holder (Staffa Motor)	1	101-4465
D	Part	HITCH PIN .148 X 2.938	1	
E	Part	3/8" UNC x 1-1/4" Hex Bolt	2	09-1048
F	Part	3/8" Lock Washer	2	09-5106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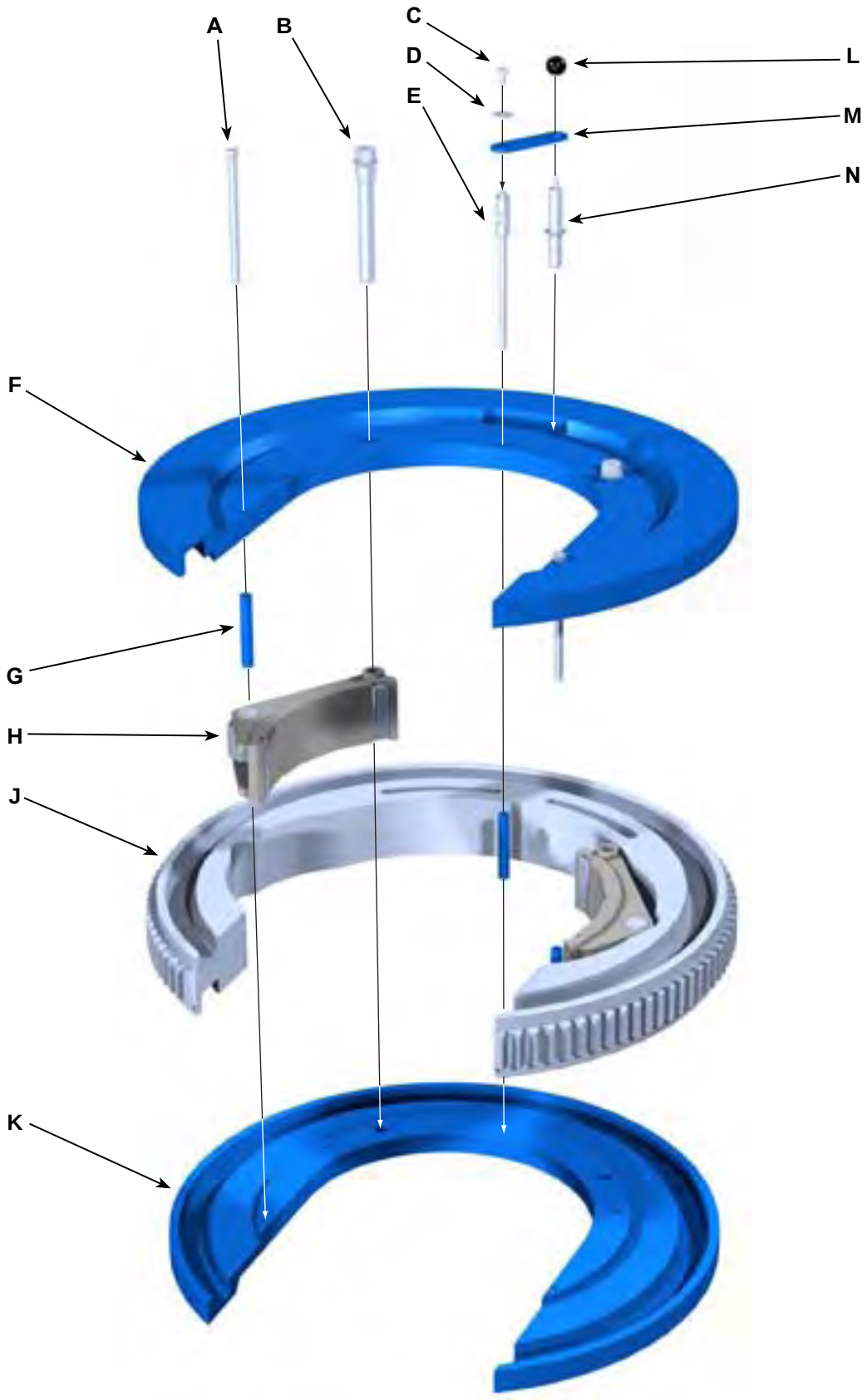
Item	Type	Description	Qty	Part Number
A	Part	Support Roller Shaft (Shown For Illustration Purposes Only)	4	101-3939
B	Weldment	Brake band Lug Weldment (RH Top, LH Bottom)	2	101-1636
C	Weldment	Brake band Weldment (Lined)	2	1037-D-63
D	Weldment	Brake band Lug Weldment (LH Top, RH Bottom)	2	101-1637
E	Part	3/8" NC Hex Nylock Nut	4	09-5607
F	Part	Brake band Spring	4	9588K340
G	Part	3/8" NC x 4-1/2" Hex Bolt	4	09-1064
H	Part	Brake band Retainer	4	101-1631
J	Part	3/8" Regular Carbon Steel Lock Washer	8	09-5106
K	Part	3/8" NC x 1" Hex Bolt	8	09-1170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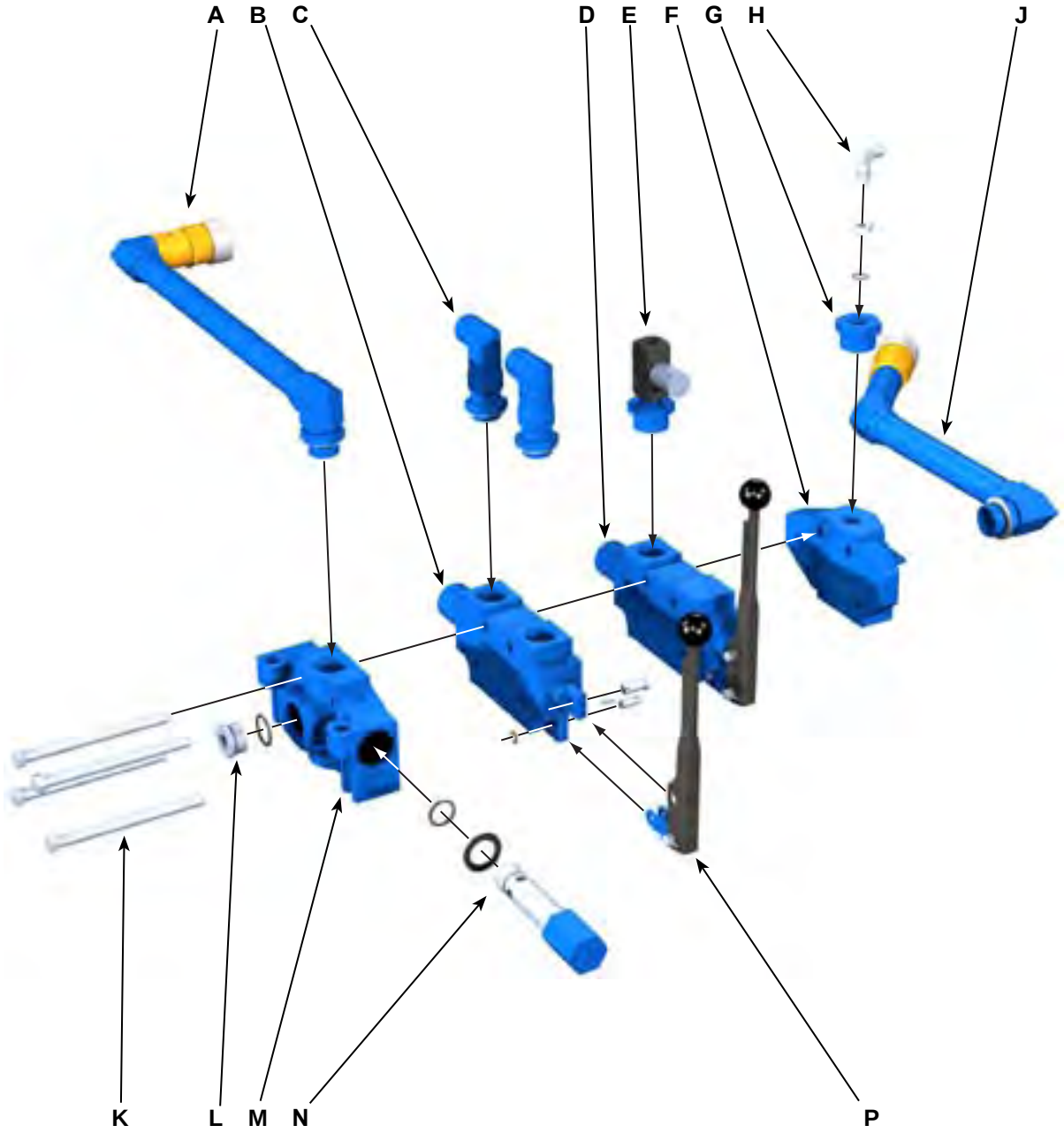
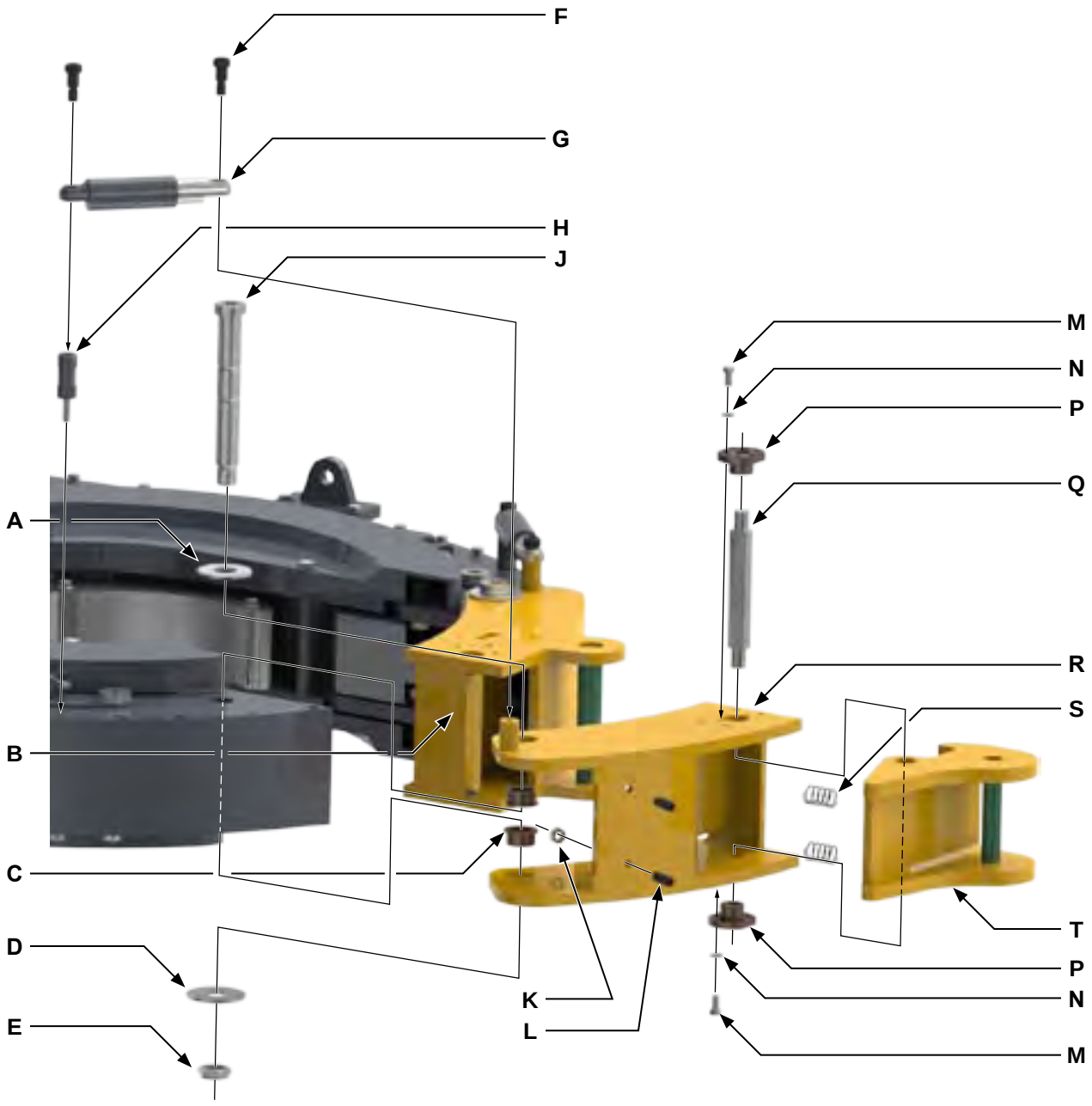
Item	Type	Description	Qty	Part Number
A	Part	1/2" NC x 8" Hex Bolt	2	09-1198
B	Part	Jaw Pivot Bolt	2	1050-C5-28
C	Part	3/8" NC x 3/4" Hex Bolt	1	09-1044
D	Part	3/8" Plain Washer	1	09-5006
E	Part	Rear Cage plate Bolt	1	1037-36
F	Part	Top Cage plate	1	101-1580
G	Part	Cage plate Spacer	3	1037-C-38
H	Assembly	Jaw Die Kit (20" shown - See Pg. 3.6)	2	
J	Part	Rotary Gear	1	1037-D-46
K	Part	Bottom Cage plate	1	1037-D-51
L	Part	Backing Pin Knob	1	02-0017
M	Part	Backing Pin Retainer	1	1037-B-54-1
N	Part	Backing Pin	1	1037-C-39A



Item	Type	Description	Qty	Part Number
A	Assembly	1" Hydraulic Line (Supply)	1	
	Part	1" Dust Cup	1	02-9213
	Part	1" Quick-Coupler Fitting	1	02-9214
	Part	1" M-NPT/F-NPT 90d Fitting	1	02-9221
	Part	1" NPT PIPE NIPPLE	1	
	Part	1" M-ORB/F-NPT 90d Fitting	1	02-9210
B	Part	DVA35-MA8 4-Way Directional Valve, SAE Port	1	10-9014
C	Part	M-ORB/JIC Long 90d 1" Fitting	2	02-9210
D	Part	DVA35-SA8 Valve	1	10-9015

Item	Type	Description	Qty	Part Number
E	Part	Flow Control Valve	1	08-9062
F	Part	Outlet Valve, DVA35-TR99	1	10-0086
G	Part	#20 Orb Plug With Machined #8 Orb Port Bushing	1	10-9068
H	Part	M-ORB/JIC 90 DEG 3/8" Fitting	1	02-9200
J	Assembly	1-1/4" Hydraulic Line (Return)	1	
	Part	1-1/4" Dust Cup	1	02-9212
	Part	1-1/4" Quick-Coupler Fitting	1	02-9215
	Part	1 1/4" M-NPT/F-NPT 45d Fitting	1	
	Part	1-1/4" NPT PIPE NIPPLE	1	
	Part	1-1/4" M-ORB/F-NPT 90d Fitting	1	02-9202
K	Part	1/2" NC x 6-1/2" Hex Bolt	4	09-1192
L	Part	1" Orb Plug Fitting	1	02-9222
M	Part	Inlet Valve, DVA35-A880	1	10-9016
N	Part	Hydraulic Relief Valve, DVA35-MRV-2	1	10-0062
P	Assembly	Hydraulic Valve Handle Assembly	2	01-0409
	Part	Hydraulic Valve Handle	1	01-0409-HANDLE
	Part	Hydraulic Valve Handle Links	1	01-0409-LINK
	Part	Hydraulic Valve Pin #1	2	01-0409-PIN1
	Part	Hydraulic Valve Pin #2	1	01-0409-PIN2
	Part	C-Clip	2	01-0409-CIRCLIP
	Part	Cotter Pin	2	01-0409-COTTER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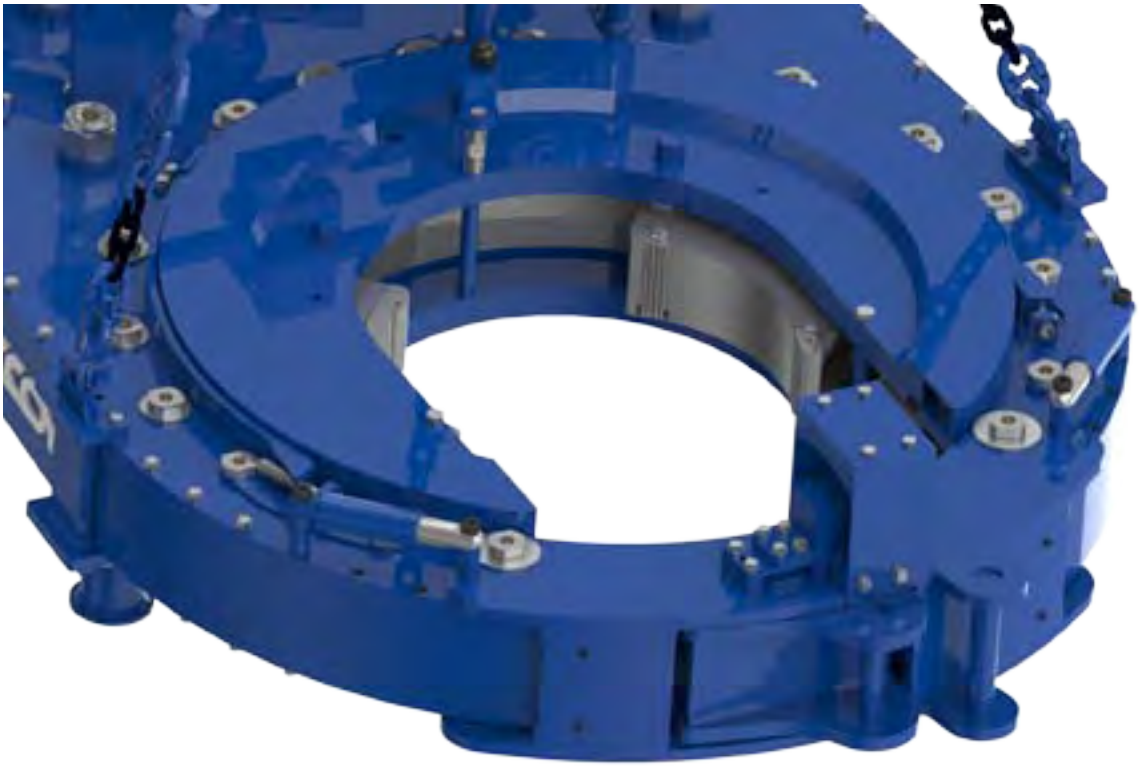
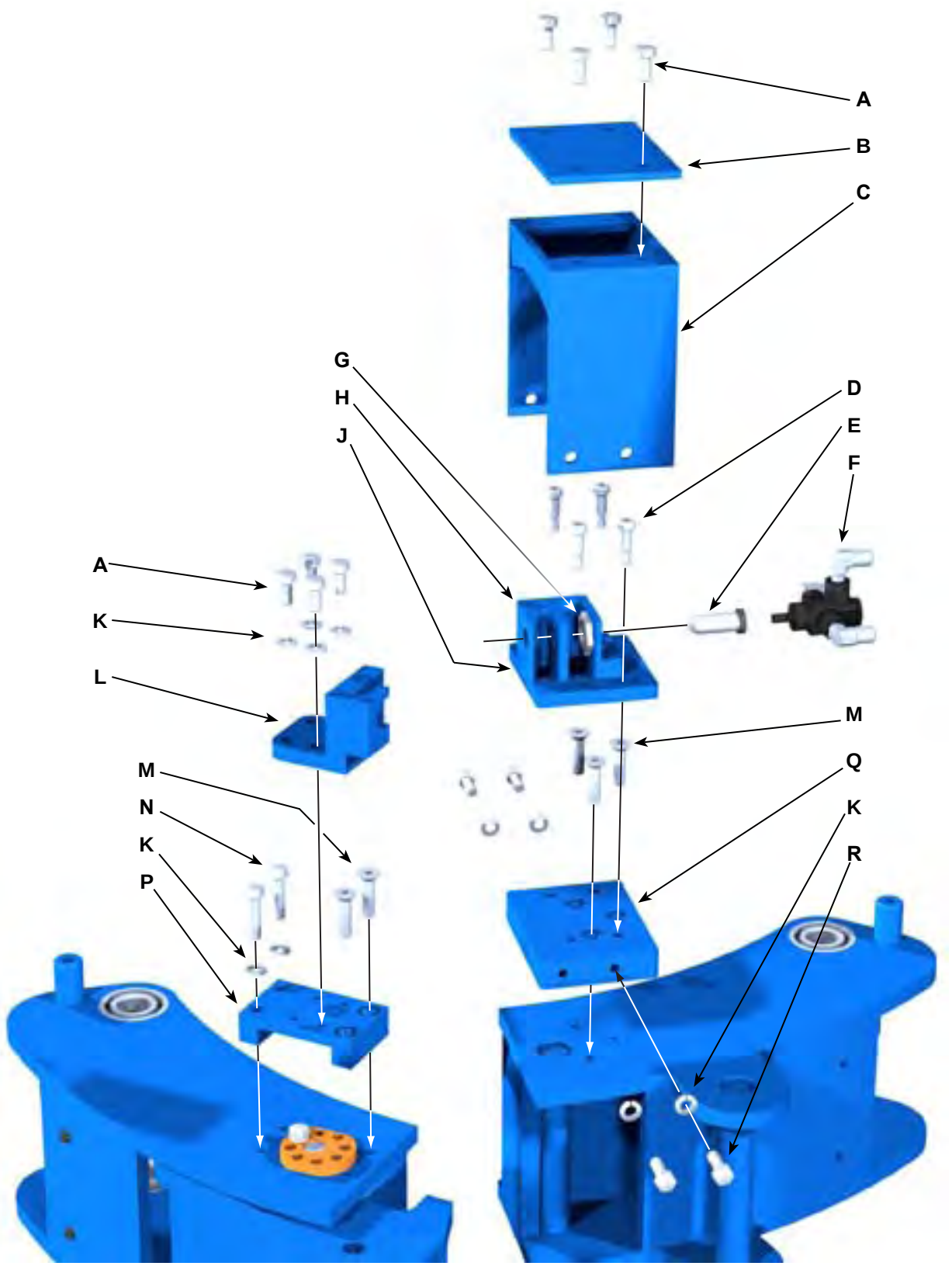


Item	Type	Description	Qty	Part Number
A	Part	1-1/8" Flat Washer	2	09-5041
B	Weldment	LH Door Weldment	1	1037-D43-142-RHA
C	Part	Door Bushing	4	101-0110
D	Part	1" Flat Washer	2	09-5026
E	Part	1" UNS Thin Nylock Nut (Support Roller)	4	09-9167
F	Part	5/8" x 3/4" UNC Shoulder Bolt	4	09-0049
G	Assembly	Door Cylinder Assembly	2	1037-A4-144
H	Part	Door Cylinder Mounting Lug	2	101-0446
J	Part	Door Pivot Roller Shaft (Support Roller)	2	101-3940
K	Part	1/2" UNC Hex Jam Nut	4	09-5810
L	Part	Unbrako Flat Point 1/2" x 1-1/2" Set Screw	4	
M	Part	3/8" NC x 3/4" Hex Bolt	2	09-2048
N	Part	3/8" Regular Carbon Steel Lock Washer	2	09-5106
P	Part	Door Latch Cam	2	1037-C-151
Q	Part	Door Latch Shaft	1	1037-C-200
R	Weldment	RH Door Weldment	1	1037-D43-142-LHA
S	Part	Door Latch Spring	2	997-16
T	Weldment	Latch Weldment	1	101-1570

See next page for safety door components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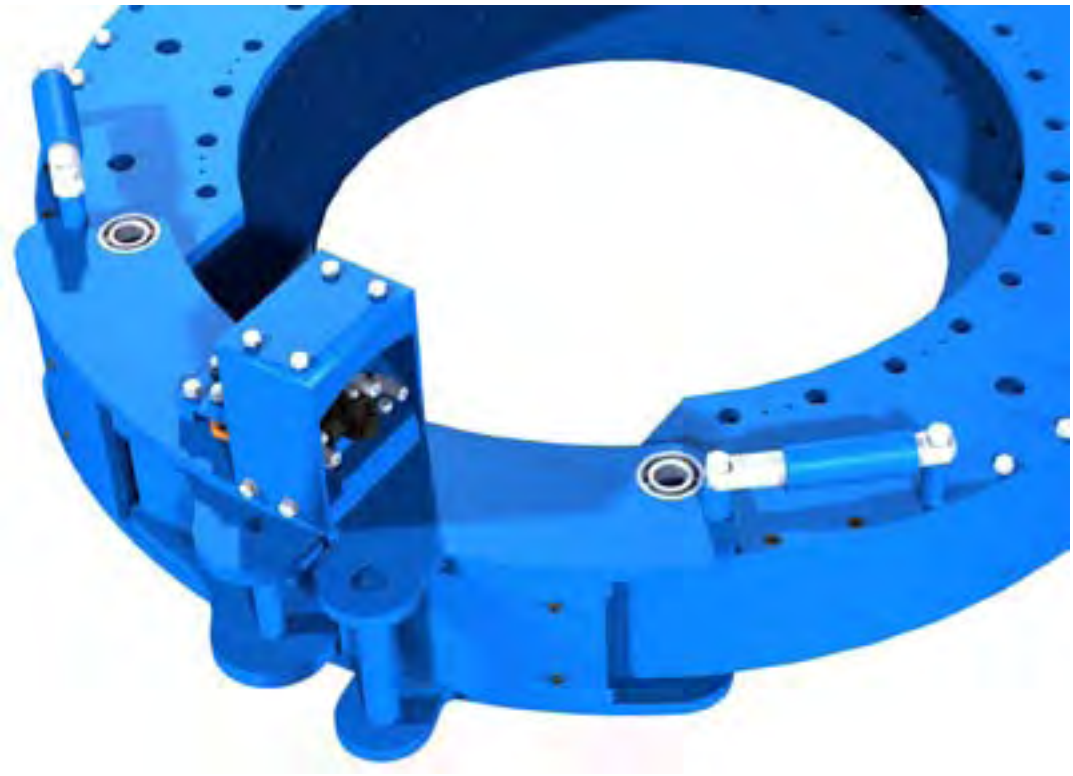
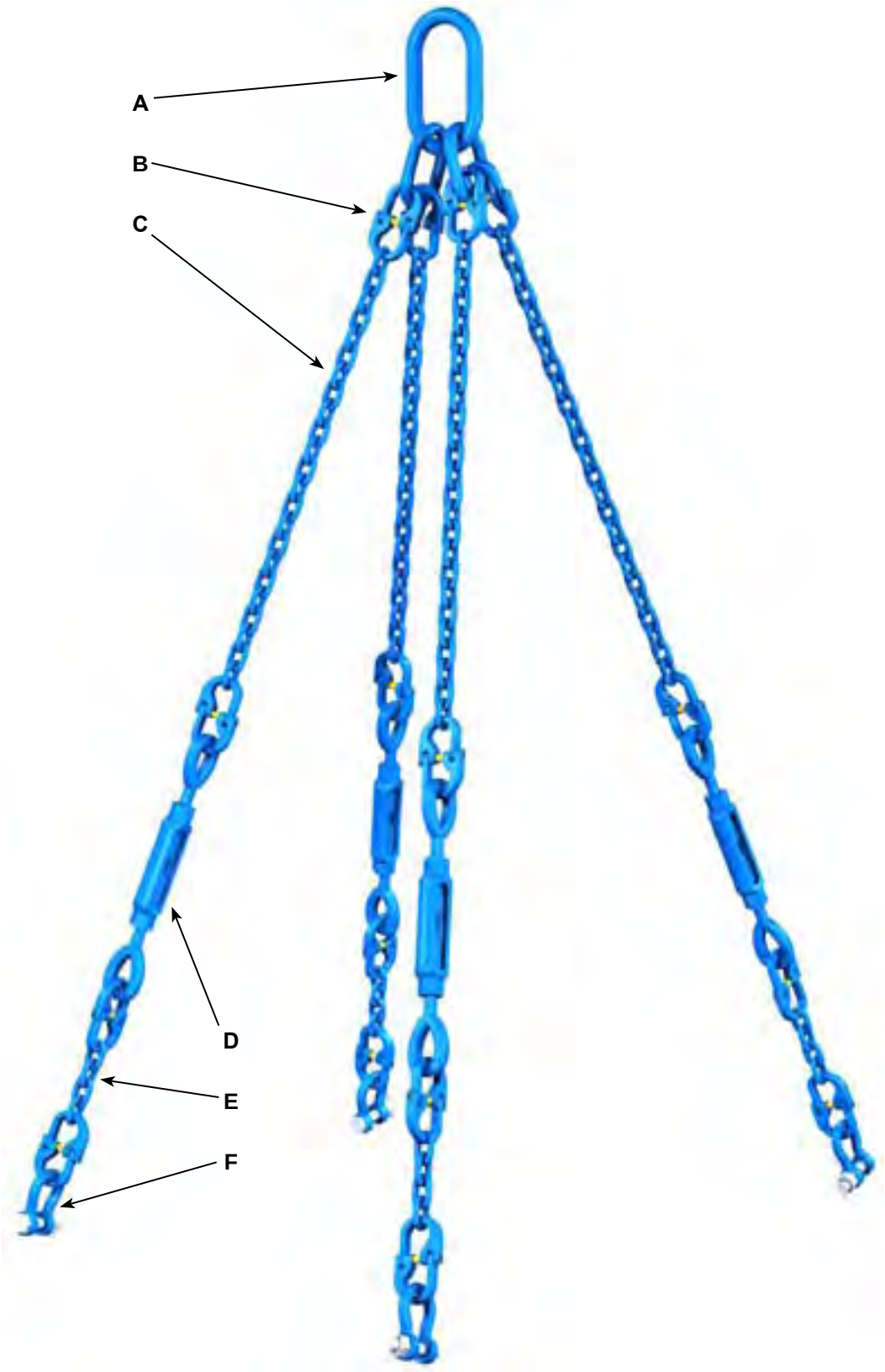


Item	Type	Description	Qty	Part Number
A	Part	3/8" NC x 3/4" Hex Bolt	8	09-1044
B	Part	Safety Door Plate	1	101-1238
C	Weldment	Safety Door Protector Weldment	1	101-0450
D	Part	Unbrako 5/16" NC x 3/4" Hex Socket Shoulder Screw	4	09-0227
E	Part	Load Plunger	1	AE12-306
F	Part	Detrol Gauge Isolator Valve GI21S	1	08-0337M
G	Part	15/16" Valve Lock Nut	1	09-0278
H	Part	LH Safety Door Latch Block	1	AE13-301S
J	Part	LH Safety Door Latch Plate #2	1	AE13-311
K	Part	3/8" Regular Carbon Steel Lock Washer	6	09-5106
L	Part	RH Safety Door Latch Block	1	AE-13-302M
M	Part	3/8" UNC x 1-1/2" Hex FHCS	5	09-4050
N	Part	3/8" UNC x 1-1/2" Hex Bolt	2	09-1050
P	Part	RH Safety Door Latch Plate	1	101-0479
Q	Part	LH Safety Door Latch Plate	1	101-0915
R	Part	3/8" UNC x 1" Hex Bolt	4	09-1170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Item	Type	Description	Qty	Part Number
A	Part	Master Link	1	02-0517
B	Part	Hammer Lock Connector (4 per chain)	16	02-0607
C	Part	25 Link Chain Set (Front)	2	101-0377
	Part	23 Link Chain Set (Rear)	2	101-0376
D	Part	Turnbuckle	4	02-6506
E	Part	4 Link Chain Set	4	101-0378
F	Part	Shackle Assembly	4	02-9063

ALL FASTENERS USED DURING REASSEMBLY OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE. THREADED FASTENERS USED IN LOAD-BEARING DEVICES MUST BE SECURED WITH RED LOC-TITE™. CHECK ALL CHAINS FOR DAMAGE BEFORE PLACING UNDER LOAD. DO NOT ALLOW CHAINS TO KINK BEFORE PLACING UNDER LOAD.

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A. BASIC TORQUE MEASUREMENT

Basic torque measurements are performed using a simple hydraulic measurement system. A hydraulic load cell connects to a calibrated torque gauge through a reinforced flexible hydraulic hose. The torque gauge is factory-calibrated to display accurate torque measurements for a tong or tong and backup assembly with a particular arm length. The arm length is a measurement from the centre of the pipe or casing to the centre of the force being applied to the load cell.

Two load cell options are available. A tension load cell is typically used with a suspended stand-alone tong. This application requires that the load cell be attached to the rear of the tong as part of the restraint line that opposes the force generated when the tong makes up or breaks out a joint. A compression load cell is used in a tong and backup assembly, and is typically located on the rear of the backup between the backup and a stationary frame. The load cell must be located in the centre of the compression force vector generated between the backup and the frame.

Hydraulic force generated by a load cell is transmitted to the torque gauge via a reinforced flexible hydraulic line. The hydraulic force is displayed as torque in units of Ft.-Lbs. The torque gauge has a red "peak torque" indicator that tracks with the torque gauge needle to the point of highest torque, and remains at the point of highest torque until manually reset. Note that every model of tong and tong and backup assembly has a unique arm length, and the torque gauge must be calibrated for that arm length. Torque gauges that are not calibrated for the arm length of the tool in service will not display correct torque. To ensure correct torque measurement, ensure the arm length or "handle" as displayed on your torque gauge matches the arm length of the tool in service as listed on the specifications page of the technical manual.

The images on this page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment.

THE IMAGES DISPLAYED ARE SUPPLIED FOR ILLUSTRATION PURPOSES ONLY

ILLUSTRATION 6.A.1: TORQUE GAUGE (FOR ILLUSTRATION PURPOSES ONLY)

ILLUSTRATION 6.A.2: TENSION LOAD CELL

ILLUSTRATION 6.A.3: COMPRESSION LOAD CELL

Torque gauges and load cells are supplied as a matched calibrated pair. Substituting one or the other will render the calibration inaccurate even if the actual model numbers appear to be identical. The serial numbers of matching load cell and torque gauges are clearly identified on the calibration certificate. Should you suspect the accuracy of your torque measurements, or wish to replace either component the pair should be returned to the factory for re-calibration before placing into service.

TORQUE GAUGES AND LOAD CELLS ARE FACTORY-SUPPLIED SUPPLIED AS MATCHED CALIBRATED PAIRS. IF REPLACING EITHER COMPONENT THE LOAD CELL AND TORQUE GAUGE MUST BE RETURNED TO THE FACTORY FOR RE-CALIBRATION BEFORE PLACED INTO SERVICE.

BASIC TORQUE MEASUREMENT (Continued:)

The images on the preceding page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment. Please note that the parts listed in the following table are correct for accurate torque measurement while using the equipment for which this manual is supplied.

THE TORQUE GAUGE USED IS FULLY DEPENDANT UPON THE ARM LENGTH AND TORQUE RANGE OF THE EQUIPMENT IN USE. THE PART NUMBERS LISTED IN THE FOLLOWING TABLE ARE CORRECT FOR ACCURATELY MEASURING TORQUE USING THE EQUIPMENT FOR WHICH THIS MANUAL IS SUPPLIED.

Item	Type	Description	Qty	Part Number
	Assembly	52" Arm - 60K Torque Gauge / Compression Load Cell Assembly	1	10-0023T
1	Part	52" Arm 60,000 Ft.-Lbs.Torque Gauge	1	10-0023G
2	Part	Tension Load Cell	1	10-0008T
3	Part	Hydraulic Hose	1	02-0069
4	Part	Torque Gauge Flange	1	997-D7-5
5	Part	Tension Load Cell Shackle	1	02-0078

Item	Type	Description	Qty	Part Number
	Assembly	Tension Load Cell, 4.08 in^2	1	10-0008T
A	Part	O-Ring	1	02-0800
B	Part	Load Cell Body	1	LC99-104
C	Part	1/4" NC x 1/2" Binding Head Machine Screw	1	09-0045A
D	Part	Stat-O-Seal	1	02-0307
E	Part	O-Ring	1	02-0350
F	Part	O-Ring	1	08-0596
G	Part	Load Cell Piston	1	LC99-101
H	Part	Load Cell End	1	LC99-003
J	Part	Flange Gasket	1	02-0073
K	Part	Load Cell Rod	1	LC99-002
L	Part	Wiper	1	08-1558
M	Part	3/8" NC x 3/8" Cup Point Hex Set Screw	2	09-0106
Seal Kit		Replacement Seal Kit 4.08 in^2 Tension Load Cell		02-4578

This is the standard tension load cell supplied by McCoy Drilling & Completions | Farr. Contact our sales department for information about optional application-specific tension load cells.

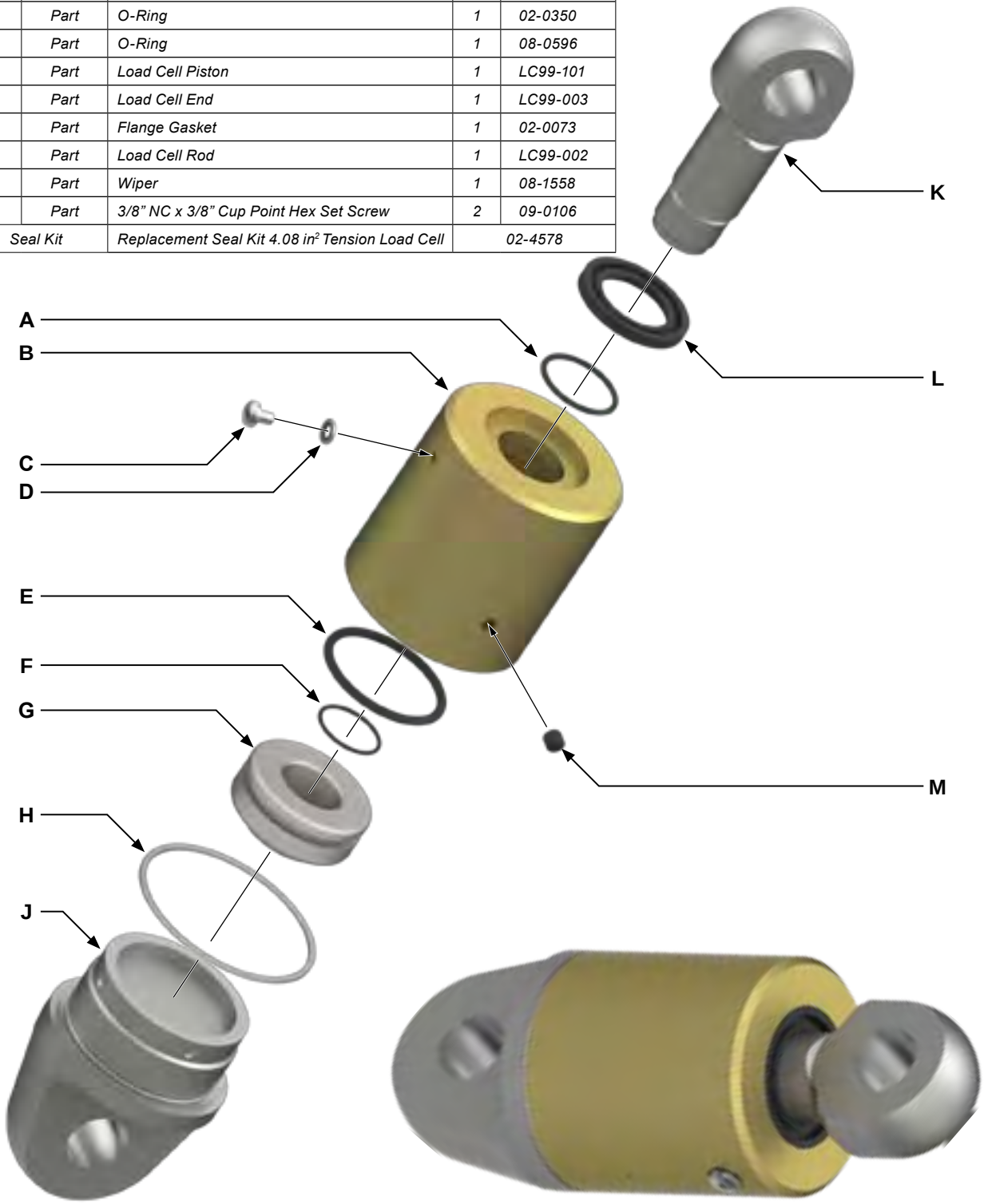
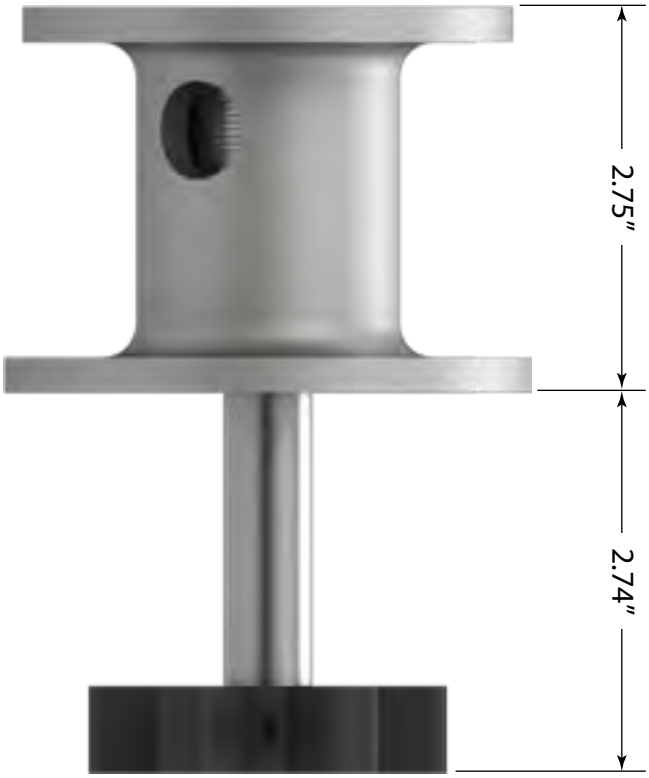
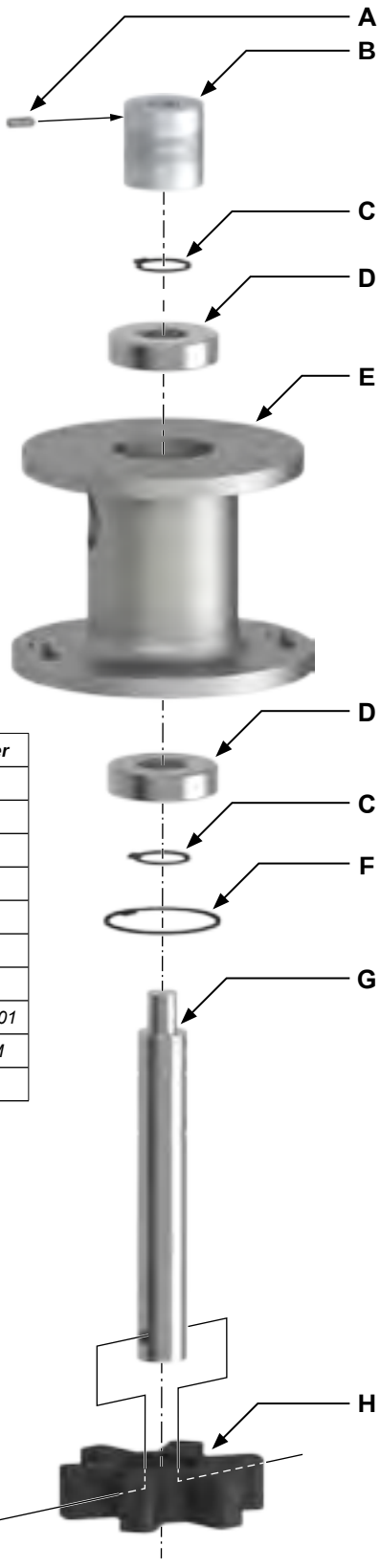


ILLUSTRATION 6.A.4: TENSION LOAD CELL EXPLODED





Item	Type	Description	Qty	Part Number
	Assembly	Standard Turn Counter Encoder Mount	1	60-0001
A	Part	6-32 x 3/8" Hex Socket Head Set Screw	4	
B	Part	Helical Flexible Encoder Shaft Coupling	1	60-0130N
C	Part	Internal Retainer Ring	2	1376-13
D	Part	Bearing	2	1376-05
E	Part	Encoder Housing	1	1392-104A
F	Part	Internal Retainer Ring	1	02-0436
G	Part	Encoder Shaft	1	1392-103A-01
H	Part	Encoder Gear	1	01-0320A-M
J	Part	10-24 x 1-1/4" Hex Socket Head Set Screw	1	

Illustration 6.A.6: Turn Counter Encoder Mount Exploded

B. TROUBLESHOOTING

Under normal operating conditions, and with proper maintenance, the torque gauge and load cell system are designed to give lasting trouble-free performance. Faulty indication on the gauge will very often define a fault within the gauge.

IF TROUBLESHOOTING REVEALS THAT THERE IS INSUFFICIENT FLUID IN THE SYSTEM, BEFORE RECHARGING, CHECK THAT ALL SYSTEM COMPONENTS ARE FREE FROM DAMAGE. THIS WILL ENSURE THAT FLUID LOSS WILL NOT CONTINUE AFTER RELOADING

1. Symptom: No indication on gauge.

Possible Problem: Obstruction in hydraulic hose.
Solutions: Check hydraulic hose for kinks.
Replace hydraulic hose.

Possible Problem: Loss of hydraulic fluid.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Internal mechanism of torque gauge is damaged.
Solution: Replace gauge.

2. Symptom: Gauge indication unexpectedly high.

Possible Problem: Excessive hydraulic fluid.
Solutions: Completely drain hydraulic fluid from torque gauge/load cell system. Recharge following the procedure in Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).
Solution: Replace gauge with gauge properly calibrated for the load cell in service.

3. Symptom: Gauge indication unexpectedly low

Possible Problem: Insufficient hydraulic fluid.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Obstruction in hydraulic hose.
Solutions: Check hydraulic hose for kinks.
Replace hydraulic hose.

Possible Problem: Snub line not at right-angle to tong handle.
Solution: Check angle of snub line and correct if necessary.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).
Solution: Replace gauge with gauge properly calibrated for the load cell in service.

4. Symptom: Gauge indication is erratic or sluggish

Possible Problem: Insufficient hydraulic fluid in torque measurement section.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Loss of damping fluid in torque gauge.
Solution: Top up or refill damping fluid (NOTE: Ensure leakage points in gauge are identified and repaired to prevent further loss of damping fluid).

Possible Problem: Air bubbles in hydraulic fluid in the torque measurement system.
Solution: Bleed air from load cell and torque gauge and top up fluid (if necessary) as per Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

C. PERIODIC INSPECTION AND MAINTENANCE

1. Inspection

The torque measurement system supplied with your equipment is designed and built to provide years of trouble-free service with minimum maintenance. Periodic inspections of the load cell, hydraulic lines and fittings are recommended in order to keep the system in top operating condition. A thorough inspection should be made at each rig-up.

2. Fluid Recharge

Recharge hydraulic system with W15/16 fluid through the check valve on the torque indicating gauge. Recharging must only be performed when there is no load on the load cell. Refer to the illustrations on pages 6.3 & 6.4 for guidance if required.

a. *Place the torque indicating gauge higher than the load cell. Remove the brass 1/4" cap from the fitting on the check valve on the top of the gauge.*

b. *Connect the hand pump to the check valve fitting.*

c. *Elevate the load cell so it is higher than the torque gauge and hand pump.*

UN-CONTAINED SPILLAGE OF THE HYDRAULIC FLUID IN THIS SYSTEM MAY CONTRAVENE GOVERNMENTAL ENVIRONMENTAL REGULATIONS, OR THE ENVIRONMENTAL REGULATIONS AND POLICIES OF YOUR COMPANY. FARR CANADA CORP. HIGHLY RECOMMENDS PLACING YOUR LOAD CELL IN A CONTAINMENT BASIN BEFORE PROCEEDING WITH THE BLEEDING & REFILLING PROCESS.

d. *Fill hand pump bowl with W15/16 hydraulic fluid.*

MAINTAIN GREATER-THAN HALF FULL FLUID LEVEL IN THE HAND PUMP BOWL TO AVOID PUMPING AIR INTO THE SYSTEM. DO NOT ALLOW THE LEVEL TO FALL BELOW ONE-HALF FULL

e. *Remove the vent plug screw and Stat-O-Seal (Items C and D on Illustration 6.A.4, or item H on Illustration 6.A.5) to allow trapped air to escape.*

f. *Pump fluid into the system until no more air is seen escaping from the vent port.*

g. *Replace the vent plug screw and Stat-O-Seal and tighten securely.*

h. *Remove load cell from containment vessel and wipe clean. Reclaim the hydraulic fluid (if it is clean) or dispose of all waste materials according to governmental or your company's proscribed environmental protection regulations.*

i. *Disconnect the hand pump from the torque gauge.*

j. *Replace the brass cap on the torque gauge check valve fitting.*

3. Repair And Calibration

Load cell and indicator gauge should be returned to authorized repair facility for any repairs or calibration required.

MOVING GLOBAL ENERGY FORWARD

DRILLING & COMPLETIONS

FARR

Section 7: Hydraulic Component Information

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Kawasaki Motors Corp., U.S.A.
Precision Machinery Division

HMB 080

Staffa Fixed Displacement Hydraulic Motor

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1. GENERAL DESCRIPTION

The HMB080 fixed displacement motor is one of 12 frame sizes in the Kawasaki "Staffa" range of high torque, low speed radial piston motors which extends from 94 to 6800 cm^3/r (5.76 to 415 in^3/r) capacity. The rugged, well-proven design incorporates hydrostatic balancing techniques to achieve high efficiency, combined with good breakout torque and smooth running capability.

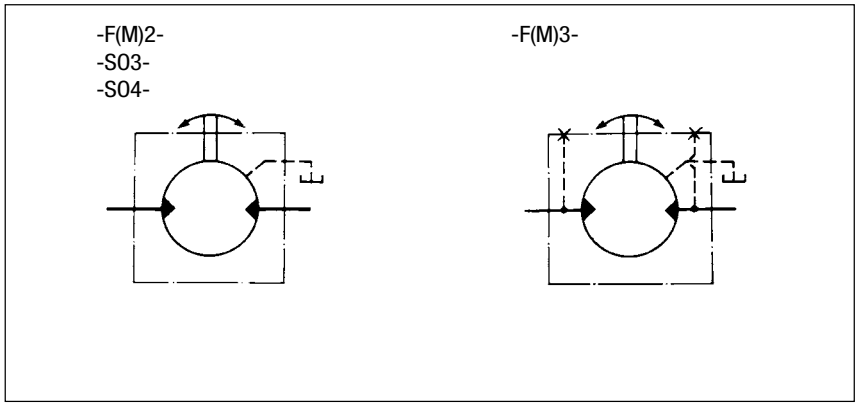
Various features and options are available including, on request, mountings to match competitor interfaces.

The HMB080 is capable of torque outputs up to 5950 Nm (4390 lbf ft) and speeds to 300 r/min with a continuous output of up to 100 kW (134 hp).

The Kawasaki "Staffa" range also includes dual and continuously variable displacement motors, plus matching brakes and gearboxes to extend the available torque range.

2. FUNCTIONAL SYMBOLS

All model types with variants in model code position **4**



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MOVING GLOBAL ENERGY FORWARD

3. MODEL CODE

Features shown in brackets ( ) may be left blank according to requirements.
All other features must be specified.

(F)-HM(*)B080-(H)*(V)-**-(**)-3*-(PL**)**

1 **2** **3** **4** **5** **6** **7**

1 FLUID TYPE

Blank = Petroleum oil
F3 = Phosphate ester (HFD fluid)
F11 = Water-based fluids (HFA, HFB and HFC)

2 MODEL TYPE

Blank = Standard ("HMB")
M = To NCB (UK) specification 463/1981 ("HMMB")
R = Dual mount (front or rear)

3 SHAFT TYPE

Use "H" prefix code as noted to specify "hollow" shafts with through hole Ø 26,2 (1.03 dia).
Hollow shafts are available only with type "S04" main port connection.
(H)P* = Cylindrical shaft with key
(H)S* = Cylindrical, 14 splines to BS 3550
(H)Z* = Cylindrical shaft to DIN 5480 (W70 x 3 x 22 x 7h)
(H)Q* = Female, 24 splines to BS 3550
T* = Long tapered, keyed shaft
X* = Short tapered, keyed shaft

* *For installations where shaft is vertically upwards specify "V" after shaft type letter to ensure that additional high level drain port is provided.*

4 MAIN PORT CONNECTIONS

Models with 2¼" distributor valve▲
F2◆ = SAE 1", 4-bolt (UNC) flanges
FM2◆ = SAE 1", 4-bolt (metric) flanges
Models with 3" distributor valve
S03 = 6-bolt (UNF) flange (Staffa original valve housing)
F3 = SAE 1¼", 4-bolt (UNC) flanges
FM3 = SAE 1¼", 4-bolt (metric) flanges
Models with 4" distributor valve■
Must be specified when requiring hollow shafts, type HP, HS, HZ or HQ
S04■ = 6 bolt (UNF) flange (Staffa original valve housing)

▲ *Gives minimum overall length of HMB080 motor*
◆ *Max. inlet flow 200 l/min (53 USgpm); reduced max. continuous speed and output power, see "Performance Data", page 4.*
■ *Obligatory for hollow shafts. See increased installation dimensions with 4" valve.*

5 TACHO/ENCODER DRIVE

T = Staffa original tacho drive
T1 = Suitable for Hohner 3000 series encoders. (Encoder to be ordered separately)
Omit if not required and when specifying shaft types "H**"

6 DESIGN NUMBER, 3* SERIES

Subject to change. Installation and performance details remain unaltered for design numbers 30 to 39 inclusive.

7 SPECIAL FEATURES

PL** = non-catalogued features, e.g.:
Stainless steel shaft sleeves
Alternative encoder and tacho drives
Alternative port connections
Shaft variants
Alternative reduced capacities
Special mountings
Special paint

** *Number assigned as required to specific customer build.*

4. PERFORMANCE DATA

Performance data is valid for Staffa HMB080 motors fully run in and operating with petroleum oil. See separate table for pressure and speed limits when using fire-resistant fluids. Leakage values are at fluid viscosity of 50 cSt (232 SUS).

MOTOR DATA

		Port connection type, see model code 4	
		SO3, F3, FM3, SO4	F2, FM2
Geometric displacement▲	cm^3/r (in^3/r)	1344 (82)	1344 (82)
Average actual running torque	Nm/bar (lbf ft/psi)	19,9 (1.01)	19,9 (1.01)
Max. continuous◆speed	r/min	300	150
Max. continuous◆output	kW (hp)	100 (134)	77 (103)
Max. continuous◆pressure	bar (psi)	250 (3625)	250 (3625)
Max. intermittent◆pressure	bar (psi)	293 (4250)	293 (4250)

▲ *Other lower displacements are made available to special order*
◆ *See "Rating Definitions", this page*

LIMITS FOR FIRE RESISTANT FLUIDS

Fluid type	Pressure, bar (psi) Continuous	Intermittent	Max. speed r/min
HFA, 5/95% oil-in-water emulsion	103 (1500)	138 (2000)	50% of limits for petroleum oil
HFB, 60/40% water-in-oil emulsion	138 (2000)	172 (2500)	As for petroleum oil
HFC, water glycol	103 (1500)	138 (2000)	50% of limits for petroleum oil
HFD, phosphate ester	250 (3625)	293 (4250)	As for petroleum oil

RATING DEFINITIONS

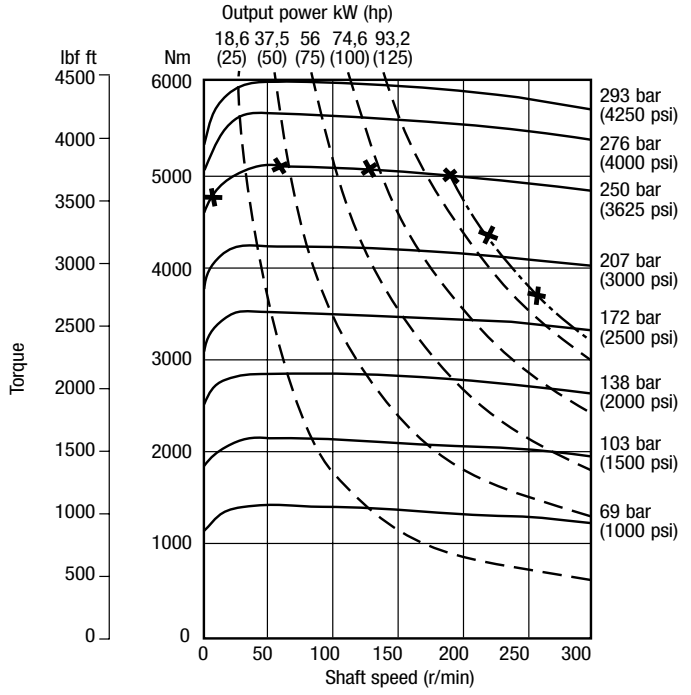
● CONTINUOUS RATING
For continuous duty the motor must be operating within each of the maximum values for speed, pressure and power.

● INTERMITTENT RATING
Operation within the intermittent power rating (up to the maximum continuous speed) is permitted on a 15% duty basis, for periods up to 5 minutes maximum.

● INTERMITTENT MAX. PRESSURE
Up to 293 bar (4250 psi) is allowable on the following basis:
(a) Up to 50 r/min: 15% duty for periods up to 5 minutes maximum.
(b) Over 50 r/min: 2% duty for periods up to 30 seconds maximum.

OUTPUT TORQUES

The torque curves indicate the maximum output torque and power of a fully run-in motor for a range of pressures and speeds when operating with zero outlet pressure on petroleum oil of 50 cSt (232 SUS) viscosity. High return line pressures will reduce torque for a given pressure differential.



–x–x–x– Upper limit of continuous rating envelope, see "Rating definitions" above.

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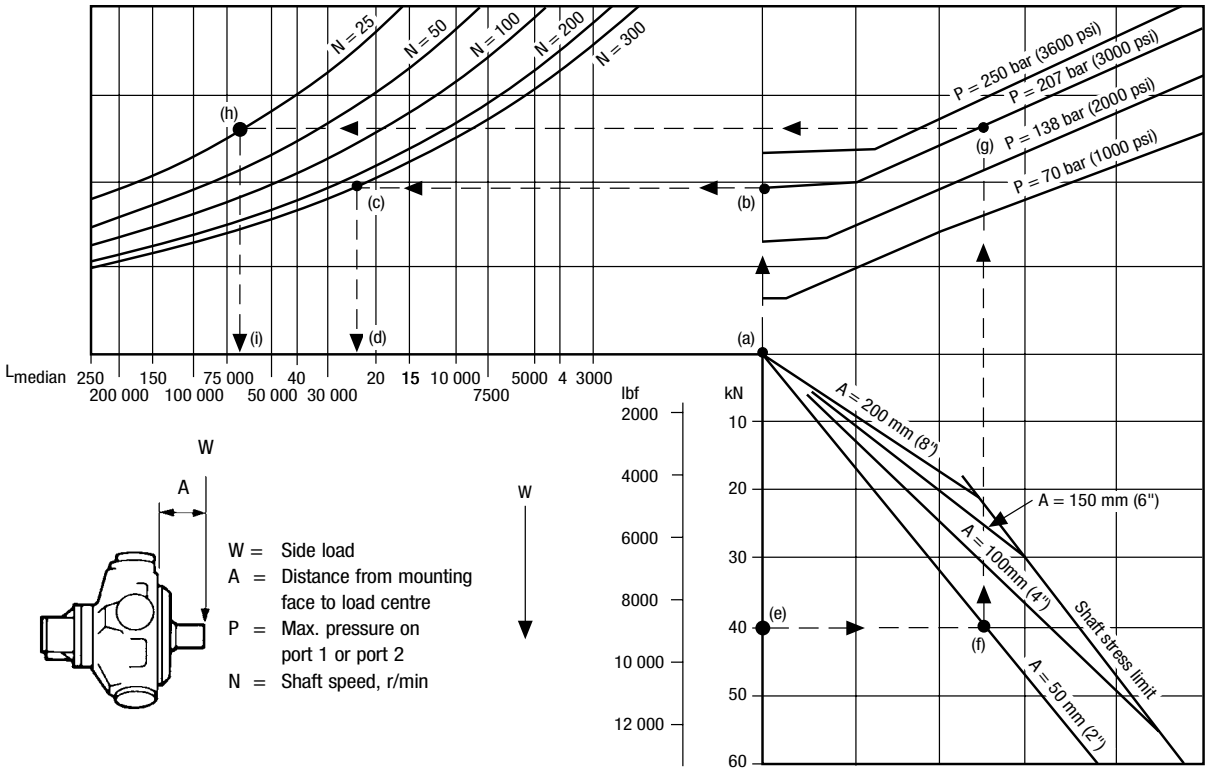
BEARING LIFE



The nomograph allows the median ▲ bearing life to be determined for conditions of:

1. No side load and no axial thrust
2. Side load and no axial thrust

▲ *To determine L10 life predictions per ISO 281-1-1977 multiply the median figure by 0.2.*

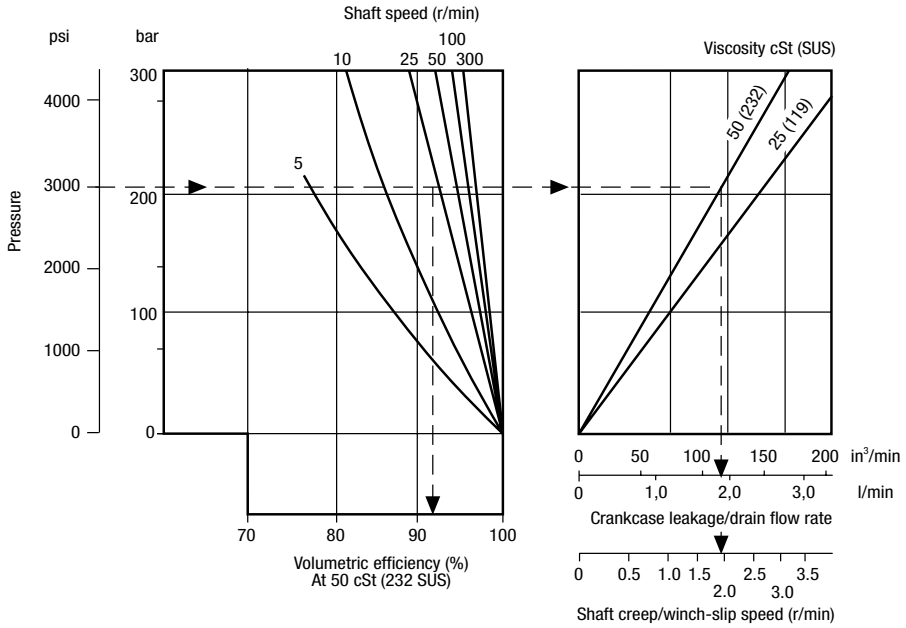
	HMB080
Example 1 (follow chain dotted line):	
Side load (W)	a) 0
System pressure (P)	b) 207 bar (3000 psi)
Speed (N)	c) 300 r/min
Median bearing life	d) 23 000 hrs
L10 bearing rating = median x 0.2	4600 hrs
Example 2 (follow chain dotted line):	
Side load (W)	e) 40 kN (9000 lbf)
Load offset (A) from motor mounting face	f) 50 mm (2.0 in)
System pressure (P)	g) 207 bar (3000 psi)
Speed (N)	h) 25 r/min
Median bearing life	i) 62 000 hrs
L10 bearing rating = median x 0.2	12 400 hrs

For more precise life prediction, or where axial thrusts are incurred, a computer analysis can be provided by Kawasaki on receipt of machine duty cycle.

● SHAFT STRESS LIMIT

The shaft stress limit in the nomograph is based on the fatigue rating of shaft types "(H)S" and "(H)P". Infrequent loading above these limits may be permitted; consult Kawasaki.

VOLUMETRIC EFFICIENCY



This nomograph enables the average volumetric efficiency, crankcase (drain) leakage and "winch slip"/shaft creep speed to be estimated.

Example (follow chain dotted line):
Given:
1. Pressure .....207 bar (3000 psi)
2. Speed .....25 r/min
3. Viscosity .....50 cSt (232 SUS)

To obtain:
4. Volumetric efficiency 91.8%
5. Crankcase leakage .....1,9 l/min (115.0 in^3/min)
6. Shaft creep speed .....1.9 r/min

The shaft creep speed occurs when the load attempts to rotate the motor against closed ports as may occur, for example, in winch applications.

5. CIRCUIT AND APPLICATION NOTES

STARTING TORQUES
The starting torques shown on the graph on page 4 are average and will vary with system parameters.

LOW SPEED OPERATION
Minimum operating speeds are determined by load conditions (load inertia, drive elasticity, etc.). For operation at speeds below 3 r/min consult Kawasaki.

HIGH BACK PRESSURE
When both inlet and outlet ports are pressurized continuously, the lower pressure in one port must not exceed 70 bar (1000 psi). Consult Kawasaki on applications beyond this limit. Note that high back pressures reduce the effective torque output of the motor.

BOOST PRESSURE
When operating as a motor the outlet pressure should equal or exceed the crankcase pressure. If pumping occurs (i.e. overrunning loads) then a positive pressure, "P", is required at the motor inlet ports. Calculate "P" according to port connection type being used, from:

$$P\ (bar) = 1 + \frac{N^2}{D_{bar}} + C\ bar$$

$$P\ (psi) = 14.5 + \frac{N^2}{D_{psi}} + C\ psi$$

Where:
N = speed, r/min
C = crankcase pressure
D = see table

Port connection type	D value
F2 & FM2	$D_{bar} = 1500$ $D_{psi} = 103$
S03, S04 F3, FM3	$D_{bar} = 10\ 000$ $D_{psi} = 690$

The flow rate of oil needed for the make-up system can be estimated from the crankcase leakage figure (see Volumetric Efficiency graph above). Allowance should be made for other system losses and also for "fair wear and tear" during the life of the motor, pump and other system components.

COOLING FLOW
Operation within the continuous ratings does not require any additional cooling.

For operating conditions above "continuous", up to the "intermittent" ratings, additional cooling oil may be required. This can be introduced through the spare crankcase drain hole or, in special cases, through the valve spool end cap. Consult Kawasaki about such applications.

MOTOR CASING PRESSURE

With the standard shaft seal fitted, the motor casing pressure should not exceed 3,5 bar (50 psi). On installations with long drain lines a relief valve is recommended to prevent over-pressurizing the seal.

Notes:

1. *The casing pressure at all times must not exceed either the motor inlet or outlet pressure.*
2. *High pressure shaft seals are available to special order for casing pressures of:*
   Continuous: 10 bar (150 psi)
   Intermittent: 15 bar (225 psi)
3. *Check installation dimensions (page 8) for maximum crankcase drain fitting depth.*

6. HYDRAULIC FLUIDS

Dependent on motor (see Model Code position **1**) suitable fluids include:

- Antiwear hydraulic oils
- Phosphate esters (HFD fluids)
- Water glycols (HFC fluids) ▲
- 60/40% water-in-oil emulsions (HFB fluids) ▲
- 5/95% oil-in-water emulsions (HFA fluids) ▲

▲ *Reduced pressure and speed limits, see page 4.*

Viscosity limits when using any fluid except oil-in-water (5/95%) emulsions are:

Max. off load .....2000 cSt (9270 SUS)
Max. on load .....150 cSt (695 SUS)
Optimum .....50 cSt (232 SUS)
Minimum .....25 cSt (119 SUS)

PETROLEUM OIL RECOMMENDATIONS

The fluid should be a good hydraulic grade, non-detergent petroleum oil. It should contain anti-oxidant, anti-foam and demulsifying additives. It must contain antiwear or EP additives. Automatic transmission fluids and motor oils are not recommended.

7. TEMPERATURE LIMITS

Ambient min. .....-30°C (-22°F)
Ambient max. .....+70°C (158°F)

Max. operating temperature range

	Petroleum oil	Water-containing
Min.	-20°C (-4°F)	+10°C (50°F)
Max.*	+80°C (175°F)	+54°C (130°F)

* *To obtain optimum service life from both fluid and hydraulic system components 65°C (150°F) normally is the maximum temperature except for water-containing fluids.*

8. FILTRATION

Full flow filtration (open circuit), or full boost flow filtration (closed circuit) to ensure system cleanliness of ISO 4406/1986 code 18/14 or cleaner.

9. NOISE LEVELS

The airborne noise level is less than 66,7 dB(A) DIN (70 dB(A) NFPA) throughout the "continuous" operating envelope.

Where noise is a critical factor, installation resonances can be reduced by isolating the motor by elastomeric means from the structure and the return line installation. Potential return line resonances originating from liquid borne noise can be further attenuated by providing a return line back pressure of 2 to 5 bar (30 to 70 psi).

10. POLAR MOMENT OF INERTIA

Typical data: 0,06 kg m^2 (210 lb in^2).

11. MASS

Approx., all models: 144 kg (317 lb).

11. INSTALLATION DATA

GENERAL

● Spigot

The motor should be located by the mounting spigot on a flat, robust surface using correctly sized bolts. The diametral clearance between the motor spigot and the mounting must not exceed 0,15 mm (0.006 in). If the application incurs shock loading, frequent reversing or high speed running, then high tensile bolts should be used, including one fitted bolt.

● Bolt torque

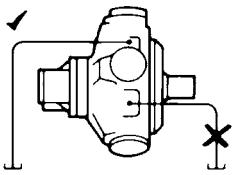
The recommended torque wrench settings for the mounting bolts are:
M20 bolts.....407±14 Nm (300±10 lbf ft)
3/4" bolts.....393±14 Nm (290±10 lbf ft)

● Shaft coupling

Where the motor is solidly coupled to a shaft having independent bearings the shafts must be aligned to within 0,13 mm (0.005 in) TIR.

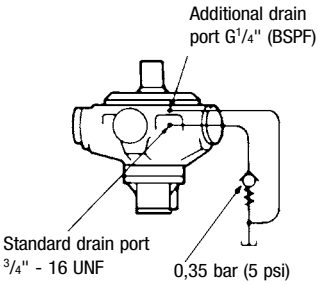
CRANKCASE DRAIN

Motor axis horizontal



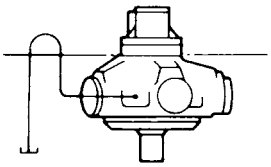
The crankcase drain must be taken from a position above the horizontal centre line of the motor.

Axis vertical, shaft up



An additional G1/4" (BSPF) drain port is provided when the "V" (shaft vertically upwards) designator is given after the shaft type letter in position **3** of the model code. This additional drain should be connected into the main motor casing drain line downstream of a 0,35 bar (5 psi) check valve to ensure lubrication of the upper bearing, see above diagram.

Axis vertical, shaft down



Use any drain position. The drain line should be run above the level of the uppermost bearing; if there is risk of siphoning then a siphon breaker should be fitted.

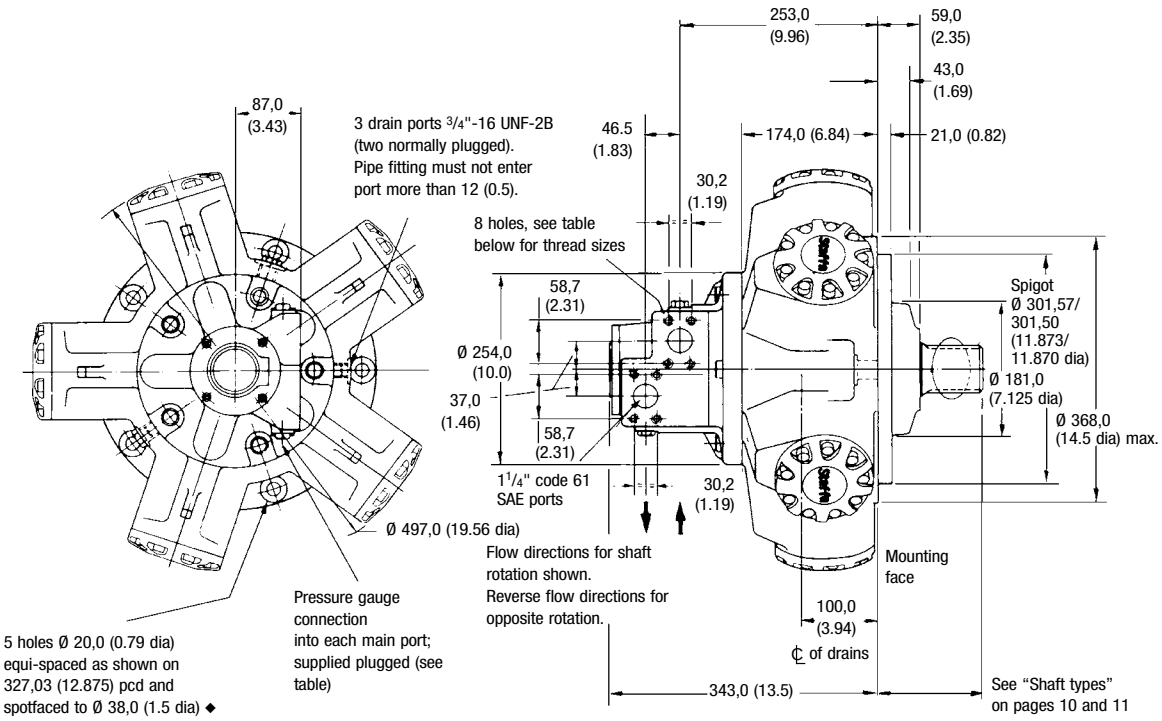
START-UP

Fill the crankcase with system fluid. Where practical, a short period (30 minutes) of "running-in" should be carried out.

13. INSTALLATION DIMENSIONS IN MM (INCHES)

FRONT-MOUNTING MODELS
HMB080 MOTORS WITH TYPE "F3"/"FM3" (1 1/4" SAE) PORT CONNECTION
See separate drawing for dual-mount model.
See additional views for shaft types and for types "S03" and "S04" port connection.
See drawing of dual-mount model for details of types "F2" and "FM2" port connection.

3rd angle projection


253,0 (9.96)
59,0 (2.35)
43,0 (1.69)
87,0 (3.43)
3 drain ports 3/4"-16 UNF-2B (two normally plugged). Pipe fitting must not enter port more than 12 (0.5).
46.5 (1.83)
174,0 (6.84)
21,0 (0.82)
30,2 (1.19)
8 holes, see table below for thread sizes
58,7 (2.31)
Spigot Ø 301,57/ 301,50 (11.873/ 11.870 dia)
Ø 254,0 (10.0)
37,0 (1.46)
Ø 181,0 (7.125 dia)
Ø 368,0 (14.5 dia) max.
58,7 (2.31)
1 1/4" code 61 SAE ports
30,2 (1.19)
Ø 497,0 (19.56 dia)
Flow directions for shaft rotation shown. Reverse flow directions for opposite rotation.
Mounting face
100,0 (3.94)
℄ of drains
343,0 (13.5)
See "Shaft types" on pages 10 and 11
5 holes Ø 20,0 (0.79 dia) equi-spaced as shown on 327,03 (12.875) pcd and spotfaced to Ø 38,0 (1.5 dia) ◆
Pressure gauge connection into each main port; supplied plugged (see table)

Port flange bolt tappings

Model code 4	Tapping size	Gauge connections
F3	7/16"-14 UNC-2B x 27,0 (1.06) full thread depth	9/16"-18 UNF-2B, SAE J475
FM3	M12 x P1.75 x 27,0 (1.06) full thread depth	G1/4" (BSPF)

◆ ⊕ Ø 0,15 (0.006)

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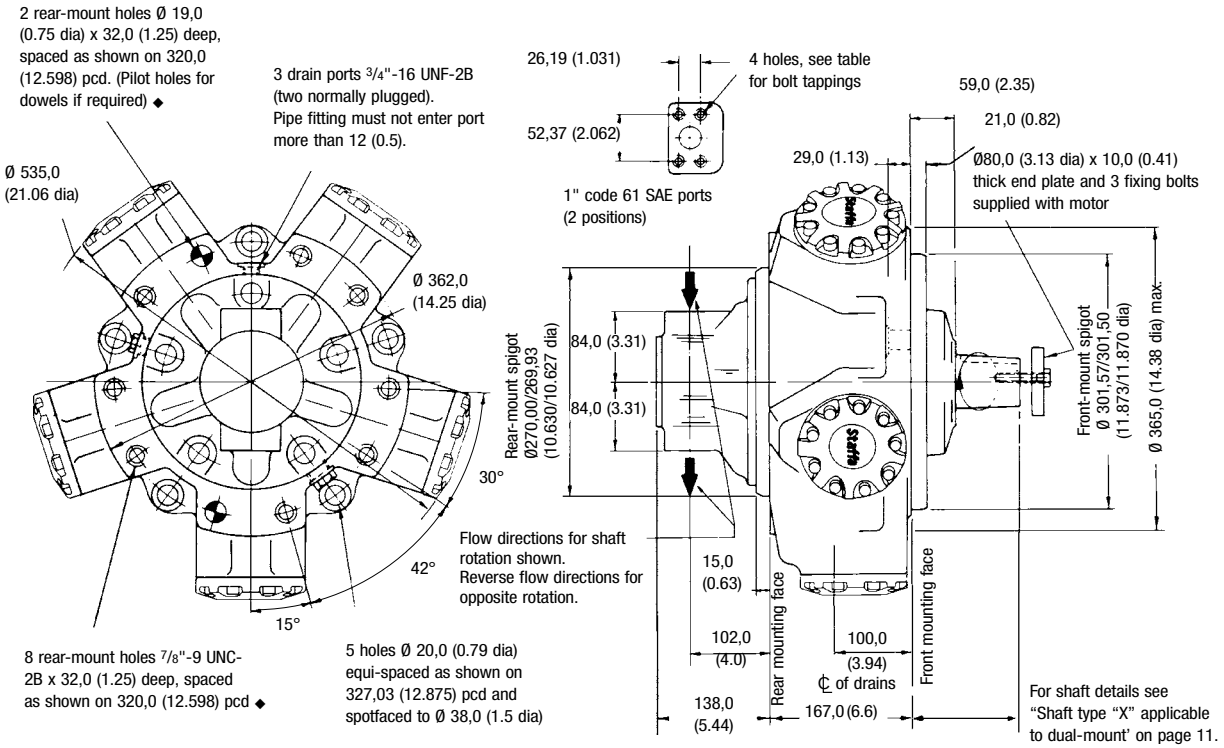
DUAL-MOUNT MODELS
HMRB080 MOTORS WITH TYPE "F2"/"FM2" (1" SAE) PORT CONNECTION
See additional views for shaft types and for types "S03" and "S04" port connection.
See drawing of front-mount model for details of types "F3" and "FM3" port connection.

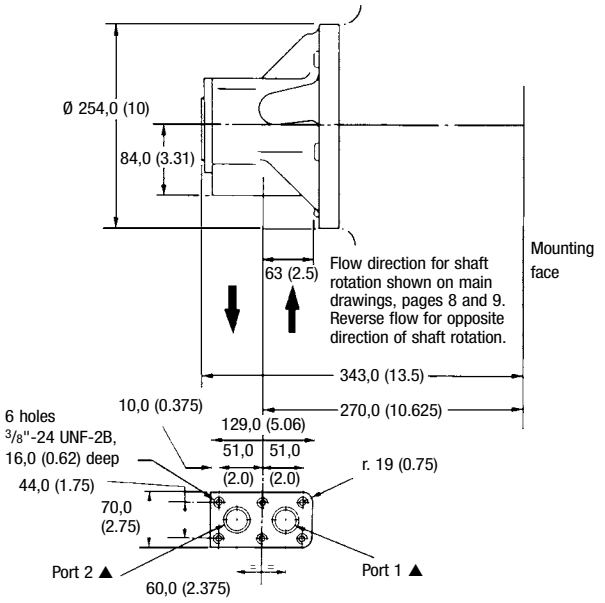

2 rear-mount holes Ø 19,0 (0.75 dia) x 32,0 (1.25) deep, spaced as shown on 320,0 (12.598) pcd. (Pilot holes for dowels if required) ◆
3 drain ports 3/4"-16 UNF-2B (two normally plugged). Pipe fitting must not enter port more than 12 (0.5).
Ø 535,0 (21.06 dia)
Ø 362,0 (14.25 dia)
30°
42°
15°
8 rear-mount holes 7/8"-9 UNC-2B x 32,0 (1.25) deep, spaced as shown on 320,0 (12.598) pcd ◆
5 holes Ø 20,0 (0.79 dia) equi-spaced as shown on 327,03 (12.875) pcd and spotfaced to Ø 38,0 (1.5 dia)
26,19 (1.031)
4 holes, see table for bolt tappings
52,37 (2.062)
1" code 61 SAE ports (2 positions)
59,0 (2.35)
21,0 (0.82)
29,0 (1.13)
Ø80,0 (3.13 dia) x 10,0 (0.41) thick end plate and 3 fixing bolts supplied with motor
Rear-mount spigot Ø270,00/269,93 (10.630/10.627 dia)
84,0 (3.31)
84,0 (3.31)
Front-mount spigot Ø 301,57/301,50 (11.873/11.870 dia)
Ø 365,0 (14.38 dia) max.
Flow directions for shaft rotation shown. Reverse flow directions for opposite rotation.
15,0 (0.63)
102,0 (4.0)
100,0 (3.94)
℄ of drains
138,0 (5.44)
167,0 (6.6)
Rear mounting face
Front mounting face
For shaft details see "Shaft type "X" applicable to dual-mount' on page 11.

Port flange bolt tappings

Model code 4	Tapping size
F2	3/8"-16 UNC-2B x 22,0 (0.87) deep
FM2	M10 x P1.5 x 22,0 (0.87) deep

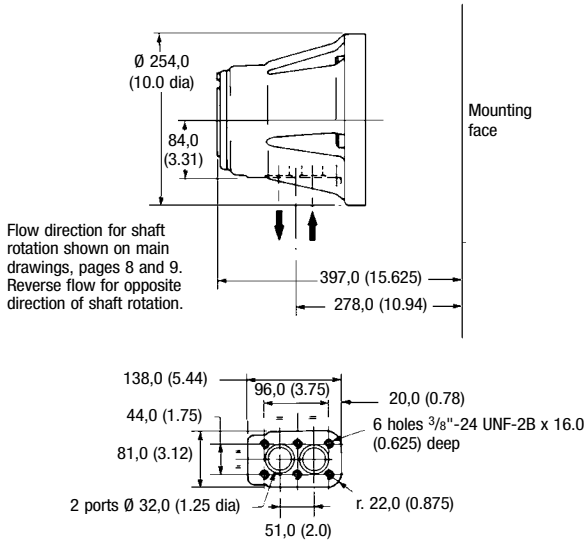
⌖ Ø 0,15 (0.006)

3" VALVE HOUSING WITH 6-BOLT FLANGE, "S03" IN MODEL CODE POSITION 4



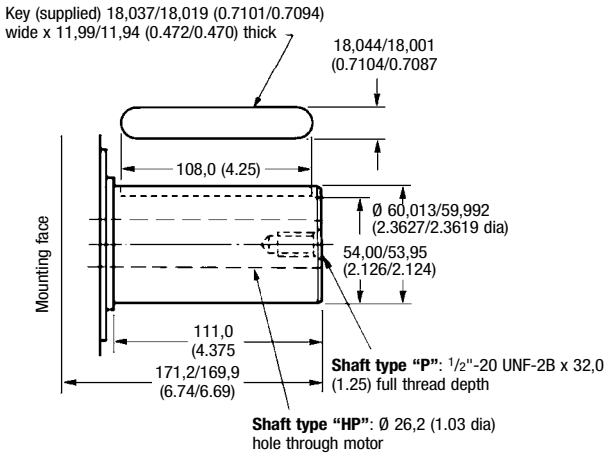
▲ *Ø 28 (1.125 dia) with recess for 31,0 (1.22) i/d x Ø 4 (0.157 dia) section O-ring*

4" VALVE HOUSING WITH 6-BOLT FLANGE, "S04" IN MODEL CODE POSITION 4


Ø 254,0 (10.0 dia)
84,0 (3.31)
Mounting face
Flow direction for shaft rotation shown on main drawings, pages 8 and 9. Reverse flow for opposite direction of shaft rotation.
397,0 (15.625)
278,0 (10.94)
138,0 (5.44)
96,0 (3.75)
20,0 (0.78)
44,0 (1.75)
6 holes 3/8"-24 UNF-2B x 16.0 (0.625) deep
81,0 (3.12)
2 ports Ø 32,0 (1.25 dia)
r. 22,0 (0.875)
51,0 (2.0)

SHAFT TYPES "P" AND "HP", MODEL CODE POSITION 3

Cylindrical shaft with key

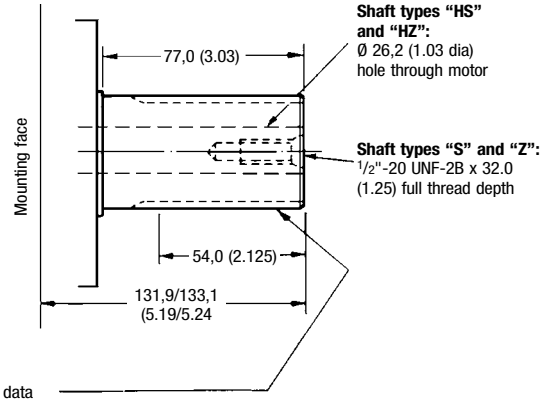


SHAFT TYPES "S" AND "HS", MODEL CODE POSITION 3

Cylindrical shaft with 14 splines to BS 3550-1963

SHAFT TYPES "Z" AND "HZ", MODEL CODE POSITION 3

Cylindrical shaft with splines to DIN 5480


77,0 (3.03)
Shaft types "HS" and "HZ": Ø 26,2 (1.03 dia) hole through motor
Shaft types "S" and "Z": 1/2"-20 UNF-2B x 32.0 (1.25) full thread depth
Mounting face
54,0 (2.125)
131,9/133,1 (5.19/5.24

Spline data

For shaft types "S" and "HS"
to BS 3550/SAE J498c (ANSI B92.1 1970 class 5)
Flat root side fit, class 1

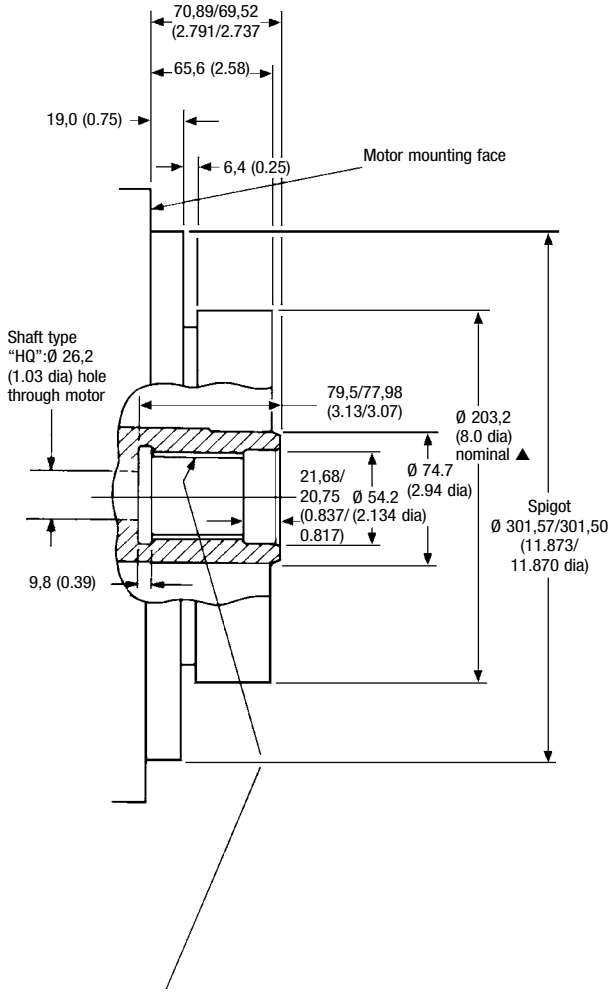
Pressure angle	30°
Number of teeth	14
Pitch	6/12
Major diameter	62,553/62,425 (2.4627/2.4577)
Form diameter	55,052 (2.1674)
Minor diameter	54,084/53,525 (2.1293/2.1073)
Pin diameter	8,128 (0.3200)
Diameter over pins	71,593/71,544 (2.8186/2.8167)

For shaft types "Z" and "HZ"
DIN 5480, W70 x 3 x 22 x 7h

SHAFT TYPES "Q" AND "HQ", MODEL CODE POSITION 3

Female shaft with 24 splines to BS 3550

Note: The "Q" and "HQ" shafts will transmit the maximum torque given on page 4. However, customers should ensure that their own mating shaft will transmit the torque required in their application.



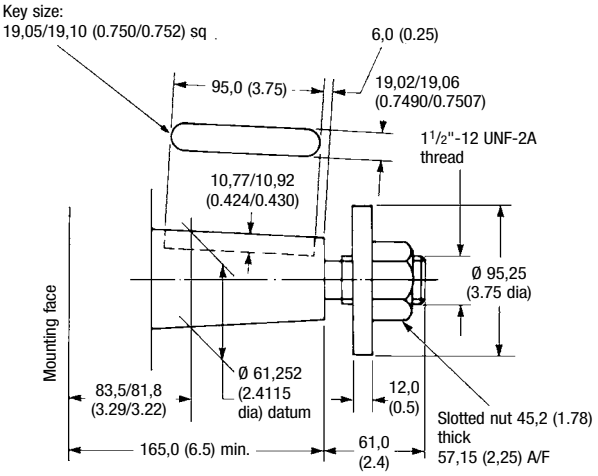
Spline data

To BS 3550	
Flat root side fit, modified	
Pressure angle	30°
Number of teeth	24
Pitch	12/24
Major diameter	53,246/52,916 (2.0963/2.0833)
Minor diameter	48,811/48,684 (1.9217/1.9167)
Pin diameter	3,658 (0.1440)
Pin flatted to	3,560 (0.1400)
Diameter between pins	45,626/45,550 (1.7963/1.7933)

▲ *Use mounting face spigot for motor location*

SHAFT TYPE "T", MODEL CODE POSITION 3

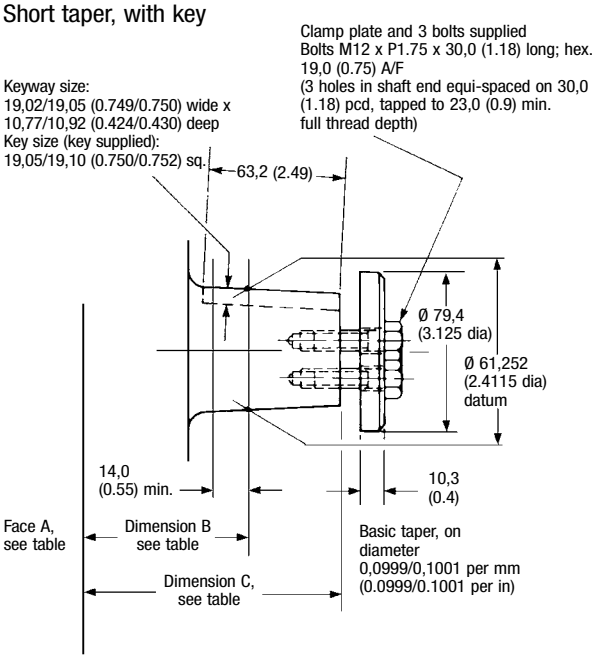
Long taper, with key



Basic taper, on diameter
0,0999/0,1001 per mm
(0.0999/0.1001 per in)

SHAFT TYPE "X", MODEL CODE POSITION 3

Short taper, with key



For front-mount models:		
Face A	=	Front mounting face
Dim. B	=	83,31/81,43 (3.280/3.206)
Dim. C	=	129,4 (5.09)

For dual-mount models:		
Face A	=	Rear mounting face
Dim. B	=	250,8/248,92 (9.874/9.800)
Dim. C	=	297,0 (11.69)

MANUFACTURER OF HYDRAULIC MOTORS
RINEER HYDRAULICS, INC.

125 Series

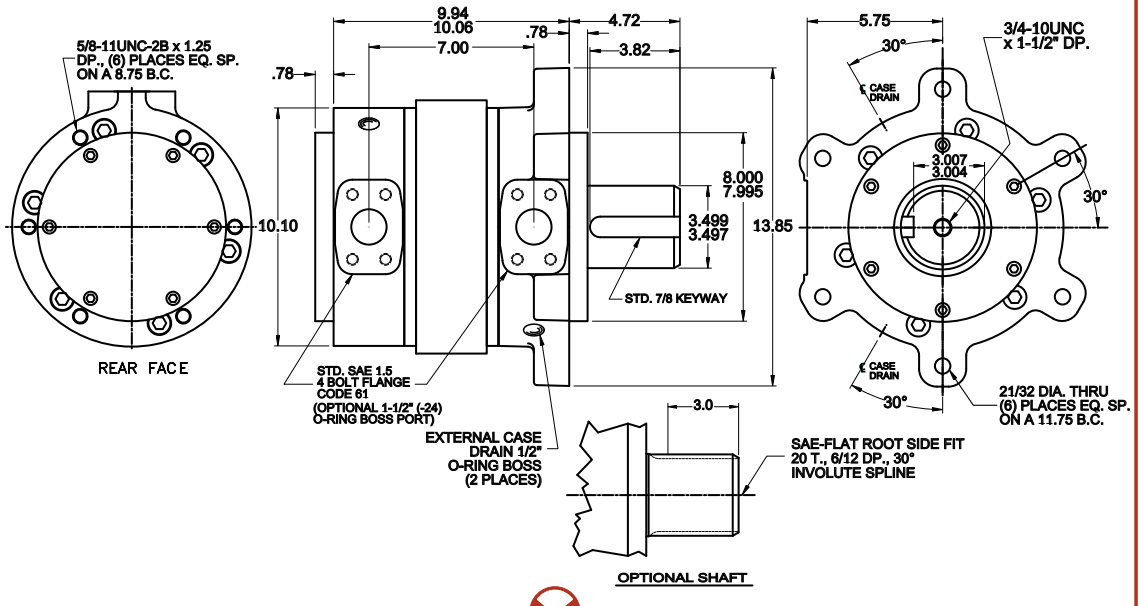
POWER to be the Best!

MOTOR SELECTION GUIDE

Features of the 125 Series Standard Motor: Standard Motor - 3000 PSI (Code 61)

- A variety of fixed displacement motors ranging from 60 in^3 to 250 in^3.
- 4-Port double motors providing 2-Speed operation with external valving.
- Starting and stall torques equal to 90-94% of theoretical torque.
- Speed to 350 RPM continuous.
- Up to 300 HP continuous.
- Compact envelope sizes.
- Weighs 225 lbs. to 280 lbs.

ENVELOPE



Made in USA

PUBLICATION DS1251005 3/04

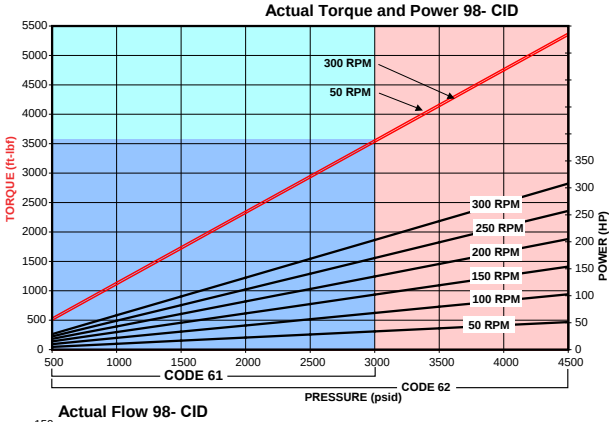
MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

Performance Data

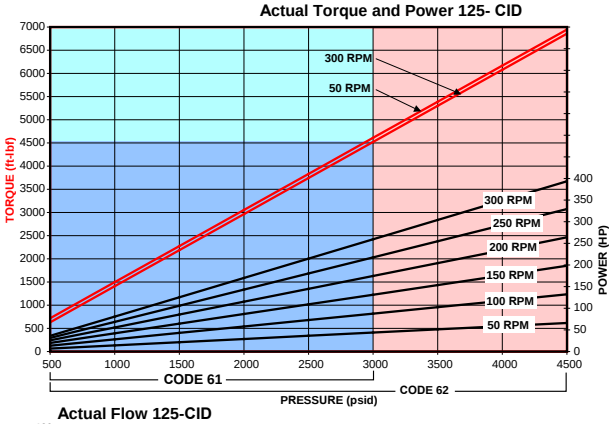
Charts shown are for 98 and 125 CID. See website at www.rineer.com for additional charts. Performance data obtained at 140°F with ISO 46 (DTE 25). Code 61 and 62 data shown. Code 62 extended data applies only to Code 62 High Pressure Series motor.

VANE CROSSING VANE - With it's vane crossing vane design, the Rineer motor produces much higher volumetric and mechanical efficiencies than is possible with a standard vane type design. This design provides a sealing vane between stator cavities to improve mechanical and volumetric efficiencies.

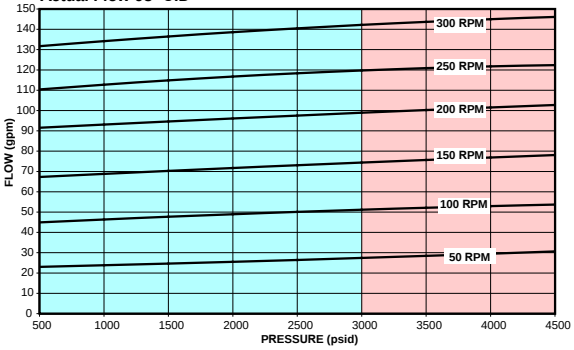
Actual Torque and Power 98- CID



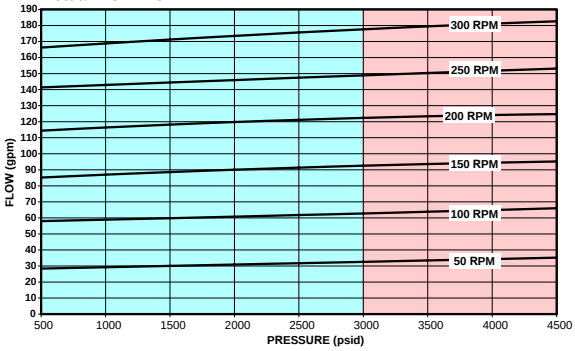
Actual Torque and Power 125- CID



Actual Flow 98- CID

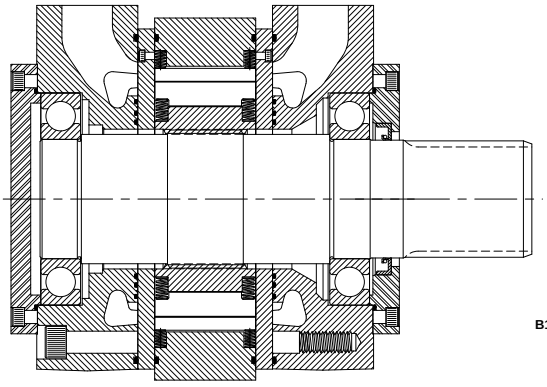


Actual Flow 125-CID



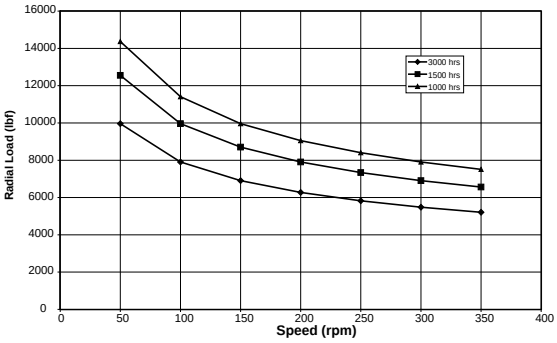
Performance of the Rineer 125 Series Motor has been greatly enhanced by internal design changes resulting in a pressure balanced rotating group. Benefits of this new design include reduced cross port leakage and increased efficiency as well as greater reliability at higher pressures. This patented design has been in effect for over 5 years.

Bearing Data - Standard Motor



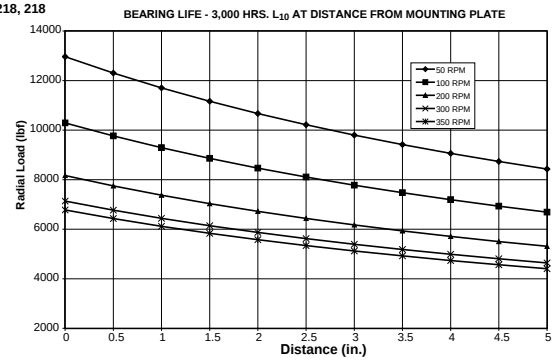
B1: 218, 218

BEARING LIFE FOR RADIAL LOAD AT 2.8" FROM MOUNTING FACE TO CENTER OF OUTPUT SHAFT



B1: 218, 218

BEARING LIFE - 3,000 HRS. L_{10} AT DISTANCE FROM MOUNTING PLATE



BEARING LOADING - The bearings in the 125 Series can accept radial load per the radial capacity charts to the right. Thrust loading is not recommended for the standard motor. For thrust-type applications, see the thrust capable motor bearing chart on the opposite page.

HORSEPOWER LIMITATION - Maximum horsepower limitation may vary with different applications. When using the 125 Series standard motor above 300HP, consult a Rineer Application Engineer.

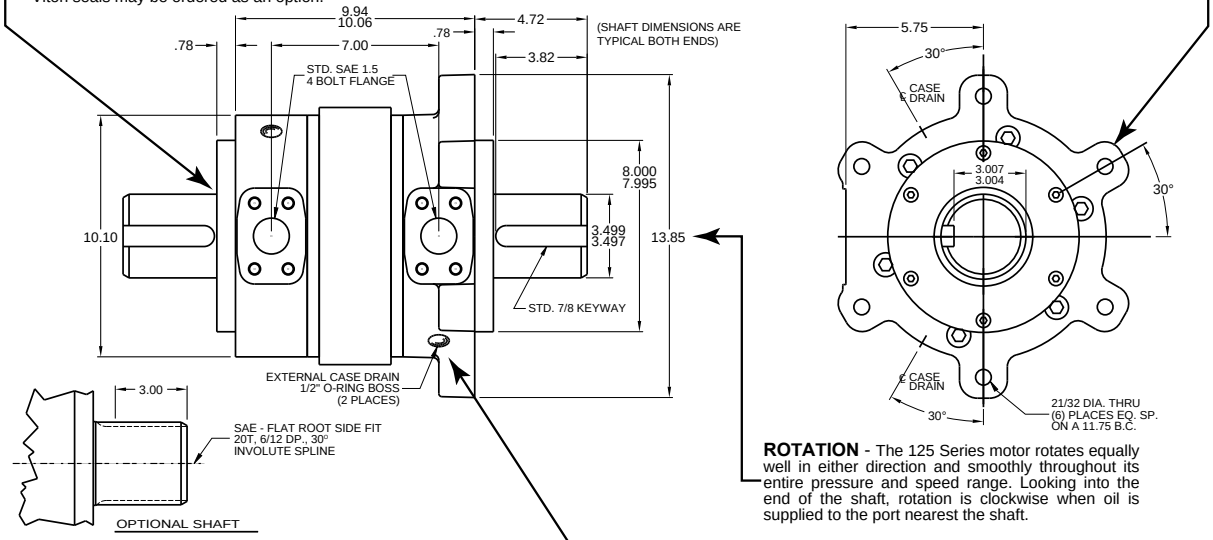
SINGLE STACKED, DOUBLE STACKED - Single stacked motors have displacements ranging from 60 in3 to 125 in3 and are comprised of a single rotor stator package located between two housings. Double stacked motors have displacements ranging from 150 in3 to 250 in3 and are comprised of two rotor stator packages located between two housings. Any of the single stacked rotor stator packages may be placed together to form a double stacked motor.

Envelope - Double Key

STARTING AND STALL TORQUE
The Rineer motor produces torque curves which are virtually flat, with starting and stall torque equal to approximately 90-94% of theoretical torque.

MORE POWER STROKES PER REVOLUTION
The 125 Series has six stator cavities and 16 rotor vanes. Each rotor vane works in each stator cavity once per revolution, which results in 96 power strokes per revolution. This helps produce higher mechanical efficiency and flatter torque curves.

SEALS - Buna N seals are supplied standard. Viton seals may be ordered as an option.



CASE DRAIN AND CROSS PORT LEAKAGE
The combined case drain and cross port leakage of the 125 Series single stacked motor is approximately 1 to 1-1/2 GPM per 1,000 PSI, while the double stack motor is approximately 2 GPM per 1,000 PSI. This will vary with the oil viscosity and internal clearance selection.

HOUSING OPTIONS - The standard 125 Series motors have one six-bolt front housing and one rear housing. Special 125 Series motors are available with two six-bolt front housings or two rear housings. The rear housing is provided with six each 5/8-11 mounting threads on a 8.750 bolt circle. The mounting position is unrestricted. The shafts, pilots, and mounting faces should be within .002 TIR.

ROTATION - The 125 Series motor rotates equally well in either direction and smoothly throughout its entire pressure and speed range. Looking into the end of the shaft, rotation is clockwise when oil is supplied to the port nearest the shaft.

FLUID - We suggest premium grade fluids containing high quality rust, oxidation and foam inhibitors, along with anti-wear additives. For best performance, minimum viscosity should be maintained at 100 SSU or higher. Fluid temperature should not exceed 180°F. Elevated fluid temperature will adversely affect seal life while accelerating oxidation and fluid breakdown. Fire resistant fluids may be used with certain limitations. Contact Rineer for additional information.

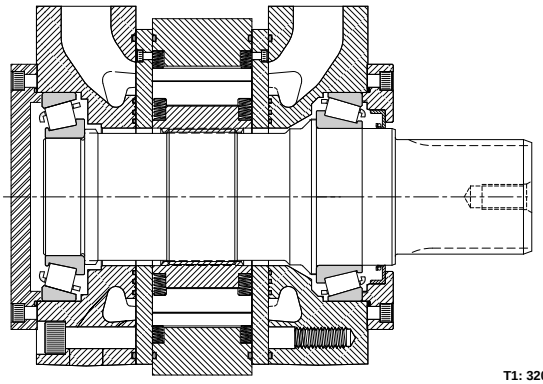
FILTRATION - 25 micron minimum.

CASE DRAIN - The 125 Series motor requires an external case drain. Two case drain ports are supplied; use the port at the highest elevation. We recommend case pressure of less than 35 PSI.
CASE DRAIN CIRCULATION - Fluid should be circulated through the two case drain ports when a temperature differential exists between the motor and the system in excess of 50°F. ***Should this occur, contact a Rineer Application Engineer.***

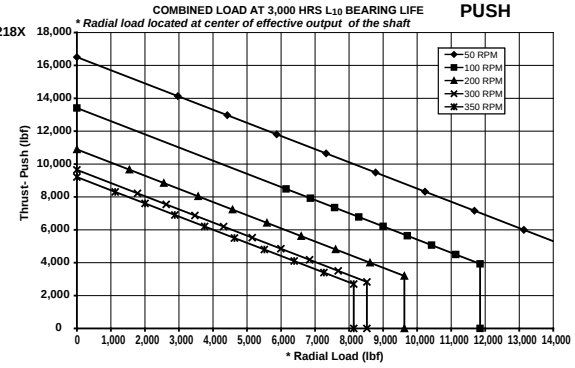
Bearing Data - Thrust Capable

BEARING LOADING THRUST CAPABLE -
The bearings in the 125 Series Thrust capable motor can accept thrust and radial load per the push/pull capacity charts to the right. Thrust loading is allowed up to the parameters indicated on the charts with shaft configurations including standard keyed and splined as well as a light duty API drill motor. For applications not requiring thrust, see the standard motor bearing charts on the opposite page.

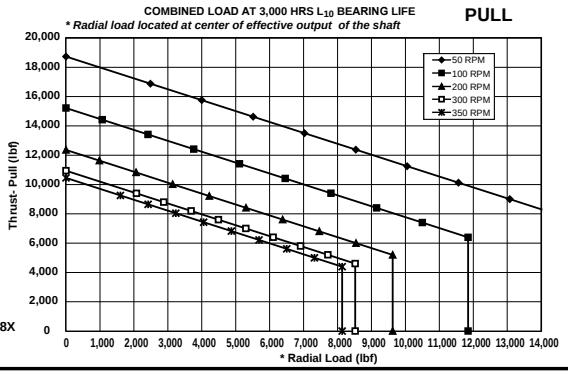
HORSEPOWER LIMITATION -
Maximum horsepower limitation may vary with different applications. When using the 125 Series standard motor above 300HP, consult a Rineer Application Engineer.



T1: 32021X, 30218X



T1: 32021X, 30218X



Model Code

M125 - A2 / A4 | **-1S** | **-125** | **-31** | **-T1** | **-TBB** | **-000**

- **-000** — Special Code Designator
- **-TBB** — Seal - Package Selection
- **-T1** — Bearing Package Selection
- **-31** — Shaft Options:
  - 30 = Keyed Shaft
  - 31 = Splined Shaft
  - 34 = Double Key
  - 35 = Female Key
  - 36 = Female Spline
  - 40 = Double Spline
  - 41 = Tapered Thrust
  - 42 = Keyed w/Opt
  - 43 = Splined w/Opt
  - 44 = Tapered w/Opt
  - 52 = Smooth Shaft
  - 53 = API Thread
- **-125** — Displacement Options

  SINGLE STACK
  - 060 = 60 in^3 (983cc)/rev.
  - 068 = 68 in^3 (1115cc)/rev.
  - 082 = 82 in^3 (1344cc)/rev.
  - 098 = 98 in^3 (1606cc)/rev.
  - 113 = 113 in^3 (1852cc)/rev.
  - 125 = 125 in^3 (2049cc)/rev.

  DOUBLE STK./4-PORT
  - 120 = 120 in^3 (1967cc)/rev.
  - 136 = 136 in^3 (2229cc)/rev.
  - 150 = 150 in^3 (2459cc)/rev.
  - 164 = 164 in^3 (2688cc)/rev.
  - 180 = 180 in^3 (2950cc)/rev.
  - 196 = 196 in^3 (3212cc)/rev.
  - 211 = 211 in^3 (3458cc)/rev.
  - 226 = 226 in^3 (3704cc)/rev.
  - 238 = 238 in^3 (3901cc)/rev.
  - 250 = 250 in^3 (4098cc)/rev.
- **-1S** — Rotary Group Designation
  - 1S = Code 61 - Standard
  - 1L = Code 61 Low Speed
- **M125 - A2 / A4** — Motor Series / Port Options:
  - A2 = Std. 2 port w/ 4-Bolt Flange ports
  - A4 = 4-Port model w/ 4-Bolt Flange ports
  - C2 = Std. 2 port w/ O-Ring Boss ports
  - C4 = 4-Port model w/ O-Ring Boss ports

Applications

For durable hydraulic motors that meet your demands, specify Rineer.

For over 35 years, we have specialized in only one thing - engineering the right motor for your needs. Rineer delivers the performance you can count on.

Visit our website at www.rineer.com

Limited Warranty Policy

Rineer Hydraulics, Inc. warrants that, at the time of shipment to Purchaser, our product will be free of defects in the material and workmanship. The above warranty is LIMITED to defective products returned by Purchaser to Rineer Hydraulics, Inc., freight prepaid within four hundred and fifty-five (455) days from date of shipment, or one (1) year from date of first use, whichever expires first. We will repair or replace any product or part thereof which is proved to be defective in workmanship or material. There is no other warranty, expressed or implied, and in no event shall Rineer Hydraulics, Inc. be liable for consequential or special damages. Dismantling the product, operation of the product beyond the published capabilities or for purposes other than that for which the product was designed, shall void this warranty.

331 Breesport San Antonio, Texas 78216
210-341-6333 Fax: 210-341-1231 e-mail: sales@rineer.com

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Repair Manual

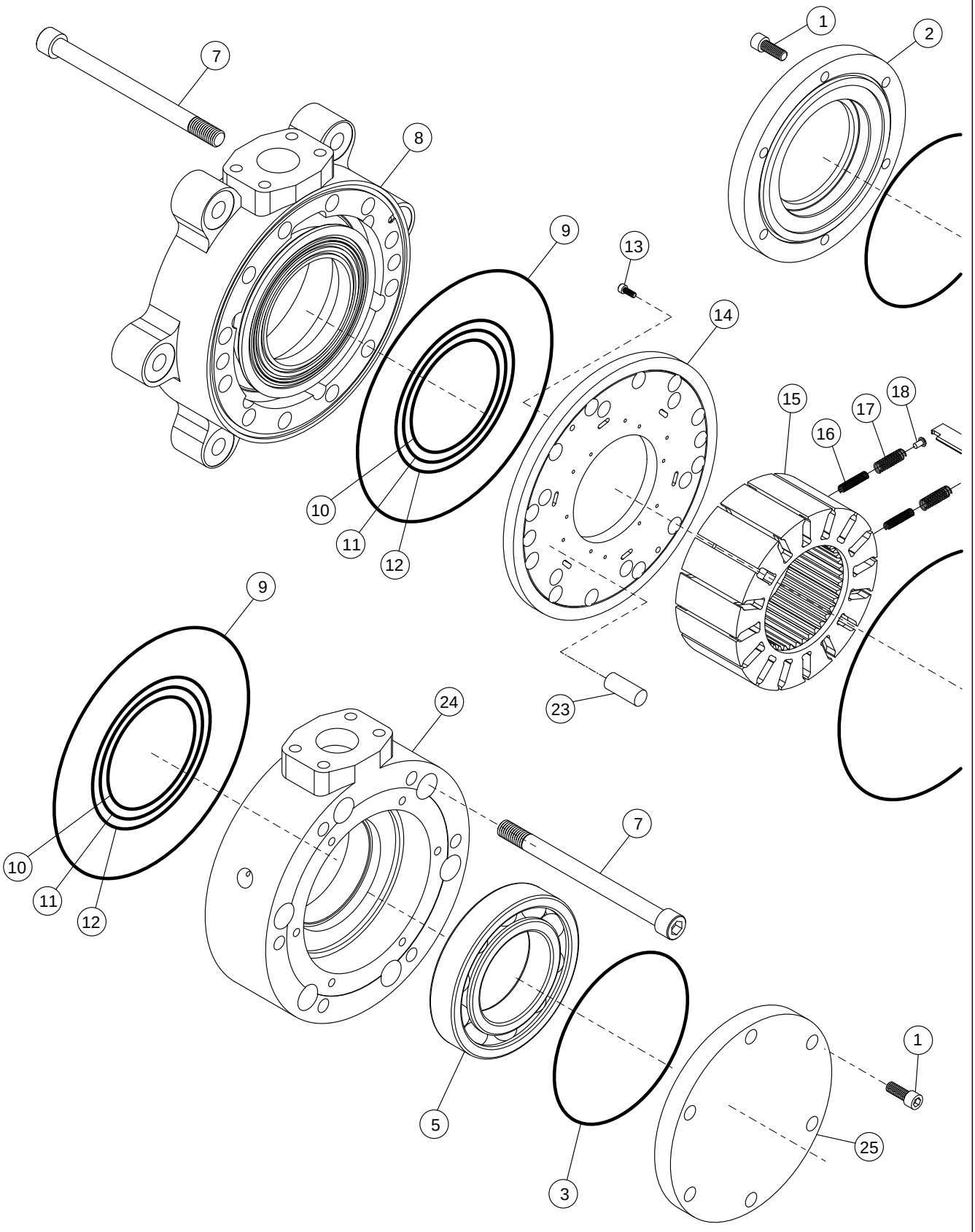
125 Series

125 Series

- Key / Spline
- Double Stack Key / Spline
- 4-Port Key / Spline
- Thru Key / Spline
- Drill Motor - API Thread

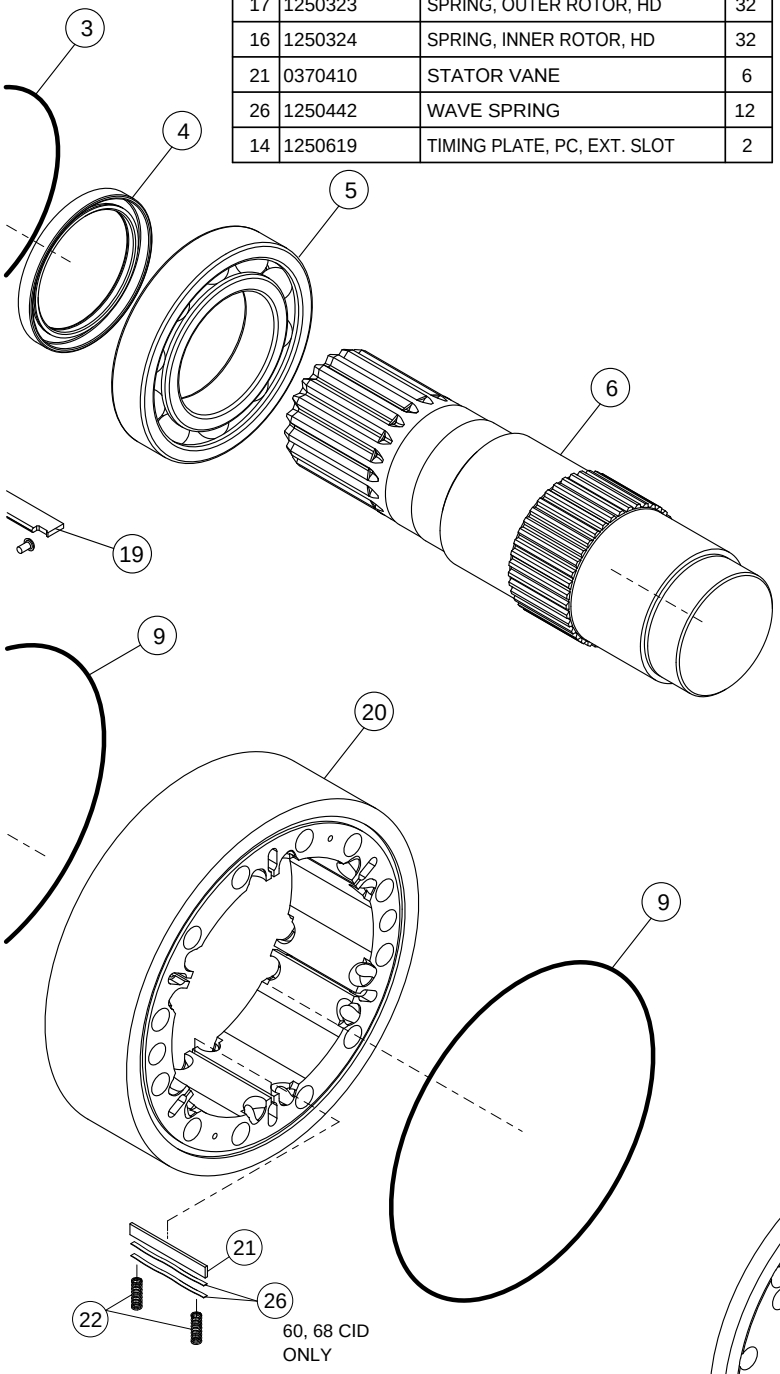
Made in USA

Data Sheet RM1255030 8/01/02



1

PARTS SUBSTITUTED IN 60 & 68 C.I.D. ROTATING GROUPS			
19	1250317PC	ROTOR VANE	16
17	1250323	SPRING, OUTER ROTOR, HD	32
16	1250324	SPRING, INNER ROTOR, HD	32
21	0370410	STATOR VANE	6
26	1250442	WAVE SPRING	12
14	1250619	TIMING PLATE, PC, EXT. SLOT	2



SERIES 125 PC EXPLODED VIEW			
ITEM	PART NO.	DESCRIPTION	QTY
1	1250117	BOLT, SEAL PLATE	12
2	1250162	SEAL PLATE, TCN, 3-1/2	1
3	1250114	O-RING, SEAL PLATE	2
4	1250187	SEAL, TCN, 3-1/2	1
5	1250711	BALL BEARING	2
6	1250702	SHAFT, SPLINED	1
	1250701	SHAFT, KEYED	1
7	0370902	BOLT, 5/8-11 x 8", MAIN	12
8	1251158	FRONT HOUSING, A, PC	1
9	1250610	O-RING, MAIN	4
10	1250877	O-RING, THERMAL, INNER	2
11	1250878	O-RING, THERMAL, MIDDLE	2
12	1250879	O-RING, THERMAL, OUTER	2
13	1250620	PLATE SCREW	4
14	1250618	PLATE, TIMING, PC	2
	1250619	PLATE, TIMING, PC (HI SPD)	2
15	1250315PC	ROTOR, S	1
	1250315PL	ROTOR, L	1
16	1250321	SPRING, INNER ROTOR	32
17	1250320	SPRING, OUTER ROTOR	32
18	1250322	SPRING BUTTON(NOT FOR 60,68)	32
19	1250314PC	VANE, ROTOR, S	16
	1250314PL	VANE, ROTOR, L	16
20	1250406	STATOR, 125 CID	1
	1250401	STATOR, 113 CID	
	1250402	STATOR, 98 CID	
	1250403	STATOR, 82 CID	
	1250404	STATOR, 68 CID	
	1250400	STATOR, 60 CID	
21	1250410	STATOR VANE	6
22	1250420	SPRING, STATOR VANE	12
23	1250440	DOWEL PIN, 5/8 x 2	4
24	1250899	REAR HOUSING, A, PC	1
25	1250817	SEAL PLATE, REAR, BLIND	1

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

Removal of Seal Plate (Front and Rear)

1

Loosen and remove (6) or (12) 3/8-16 seal plate bolts.

2

1) Lift up on the seal plate. Protect the shaft seal from being cut by the keyway (keyed shaft) by placing a thin strip of metallic tape over the shaft. Smooth any burrs that may tear or snag the seal.
2) Remove seal plate o-ring from groove in seal plate.

NOTE:
The shaft seal on a std. motor is pressed into the seal plate and can be removed in the reverse manner.

3

1) Loosen and remove (6) or (12) 3/8-16 bolts from rear seal plate. If motor has double ended shaft, remove seal plate following same precaution as stated above for front seal.
2) Remove seal plate o-ring from groove in seal plate.

Removal of Shaft and Bearings

4

Press shaft and front bearing out of motor through front housing, leaving rear bearing in place.

5

Front bearing can be inspected in place on the shaft, or pressed off to be inspected or replaced.

Disassembly of Motor

6

The 125 motors should be positioned as shown in a suitable mount to hold the unit during main bolt removal. To ensure proper orientation during reassembly, use a laquer paint pen or some type of oil/solvent proof marker to mark a line down the side of the motor.

7

Loosen and remove the six 5/8-11 main bolts. Any bolt heads showing heavy corrosion or signs of rounding of the hex form should be replaced.

8

Turn the motor over. Attach some type of plate or bar to the rear housing port pad to secure the motor for removal of remaining 5/8-11 main bolts. Take precautions to ensure that no damage is done to the port face in the area where the o-ring seals.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

9

Remove front housing as shown. Remove o-rings from housing and dowel pins from the rotating group.

10

1) Remove rotating group from rear housing as shown. Place the rotating group on a clean surface for disassembly and inspection.
2) Remove dowel pins and o-rings from the housing.
NOTE: DOUBLE STACK
When disassembling a double stack, the rotating group next to the rear housing has the center plate attached. Remove this rotating group first, then carefully remove front group.

Disassembly of Rotating Group

11

1) Place cartridge on any object which will hold it off the table.

2) Remove two each 10-32 plate screws.

3) Remove timing plate.

12

Using a small screwdriver or pick, remove o-ring and all rotor and stator springs.

Note:
Some series rotating groups may contain additional "wave" springs in the stator vane slot (see inset).

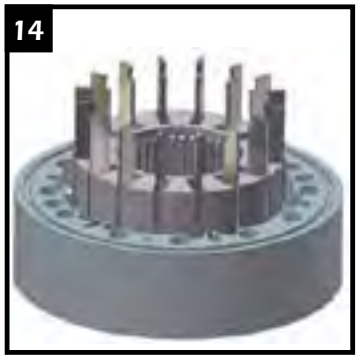
13

1) Replace plate on rotor/stator cartridge.

2) Turn rotor/stator cartridge over.

3) Repeat steps 11 & 12.

14



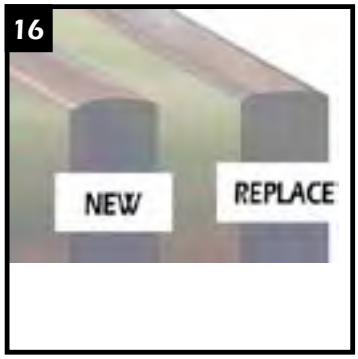
1) Remove the rotor.
2) Remove both the rotor and the stator vanes.
NOTE: On motors manufactured prior to 1987, rotor vane slots and rotor vanes should be numbered so that vanes can be reassembled in the same vane slot.
3) Separate parts and rinse in solvent tank.

Inspection of Parts

15

Inspect all parts and replace any parts which obviously show excessive wear or damage.
We recommend changing all springs and seals whenever the motor has been disassembled.

16



VANES:
Normal wear results in slight flattening of vane tips which does not impair motor performance. Replace vane if radius is reduced by 50%. Clearance between the rotor vane and rotor vane slot varies with the vane selection. The design allows the vane to "lean" slightly in the slot, providing the required mechanical seal.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

Assembly of Motor

17

PLATES:
Normal wear results in marking or polishing of the timing plate surface, which does not impair motor performance.
Replacement of the timing plate is required if any smearing, galling, or heat cracks are present.

18

ROTOR: Normal wear results in polishing of rotor faces which does not impair motor performance. Examine the rotor vane slots closely. Polishing down in the slots is normal, but if there is any indication of a "pocket" forming in the wall of the slot, the rotor should be replaced.

19

STATOR: Normal wear results in polishing of cam form which does not impair motor performance. Noticeable wear may be apparent along the corner of one side of the stator vane slot. This does not necessarily require replacement of the stator, but may slightly affect volumetric efficiency.

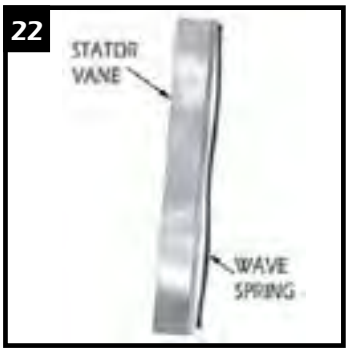
20

Measure the rotor and stator length to the fourth decimal point and supply measurement when ordering rotor, stator, or vanes.

21

1) Reverse the procedures in steps 13, 12, 11, and 10.
Before installing timing plate onto completed sides of rotating group, pour a small amount of hydraulic oil onto rotor surface.
2) NOTE: Make sure that the radiused edge of each stator vane points to the rotor and the radiused edge of each rotor vane points to the stator.
3) NOTE: Make sure springs are seated in the bottom of the spring pocket in both the rotor and stator.
NOTE: Do not allow the coil of any spring catch on the edge of the rotor or stator vanes.

22

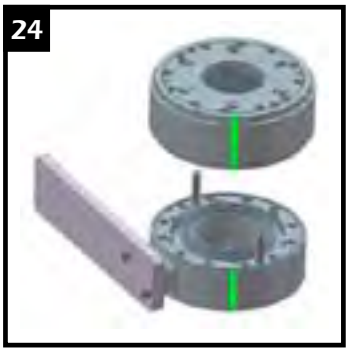


Wave springs in the 125 series do not need to be replaced. Certain model codes do not contain wave springs, while other model codes may contain two per vane. Place the stator vane and wave spring in the stator vane slot simultaneously. Note orientation as shown. Do not let the coil spring loop catch between the wave spring and vane.

23

Using a medium India honing stone, lightly dress all machine surfaces to remove any raised metal or burrs. Pay particular attention to the front and rear housing machined faces. Rough handling can cause raised surfaces near the O.D. of the housings which will prevent proper seating of the timing plates to the machined surfaces of the housing. NOTE: The pedestal surface (center of the front and rear housing containing two or three o-rings) is .002-.003 below the outer machined surface. Dress these surfaces independently.

24



Assemble the motor by reversing the previous procedures. Insure that the main body and pedestal o-rings are held in place by using an adequate amount of grease in the o-ring grooves. Line up the housings and rotating group with the paint line made on the motor in step 6.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

Motor Assembly Tips

25

Note:
On double stack motors, rotor vane slots must line up.
1) Place both rotors on the spline of the shaft, rotating one rotor until vane slots line up.
2) Mark the end of one spline tooth inside each rotor where they meet with white out. This will allow visual realignment after motor is assembled.
3) When motor is assembled, make sure marks line up before installing shaft. Be careful not to rotate one rotor independently of the other while installing the shaft.

26

Grease the first inch of threads and UNDER the head of the 5/8-11 bolts and insert into motor. Set torque wrench as specified for type of motor to be assembled (see back cover of this manual) and tighten in a star pattern. Install shaft, bearings, and seal plate in reverse order of previous procedures. Rotate shaft to insure no binding is present.

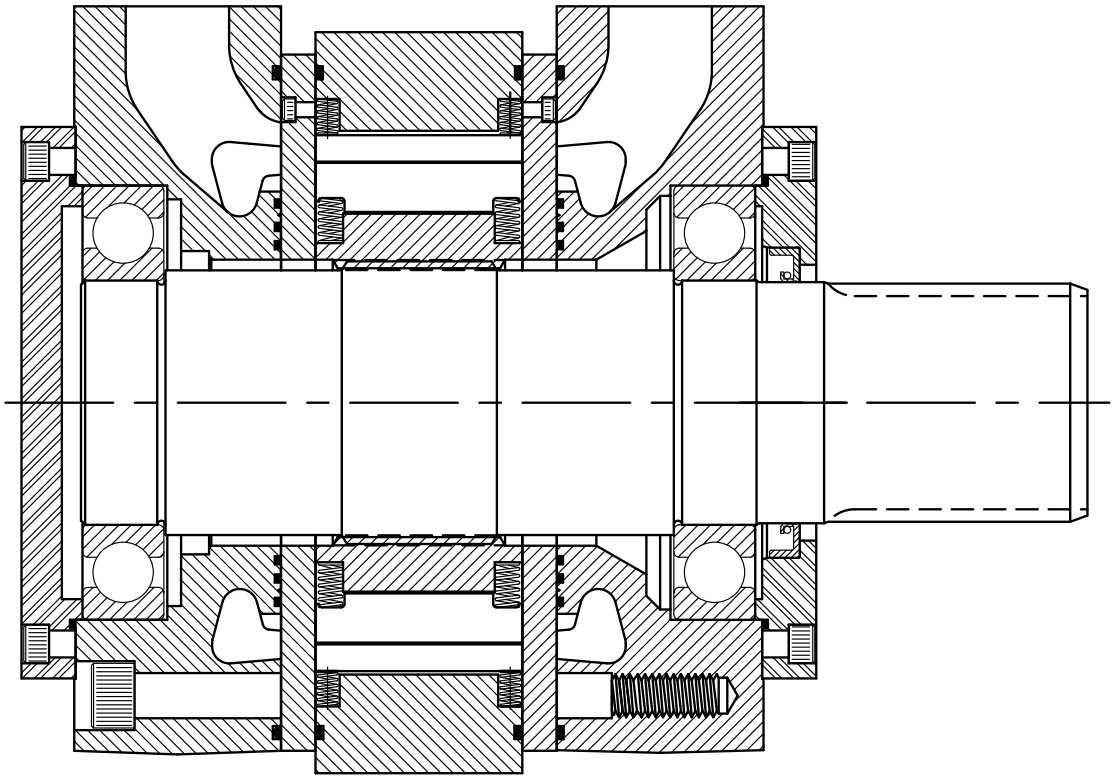
Information:

Bolt Torque -
Single Stack Main Bolts (5/8-11): 200 ft. lbs.
Double Stack Main Bolts (5/8-11): 220 ft. lbs.
4-Port Main Bolts (5/8-11): 200 ft. lbs.
Seal Plate (3/8-16): 45 ft. lbs.
Grease used for bolt threads
and o-ring retention:
Pennzoil 707L RED
Shaft seal assembly lube:
Mobilgrease special
with Moly

Seal Kits:
Standard 125 series seal kit
KT-SE1250948
Standard 125 thru-key seal kit
KT-SE1250947
Standard 125 drill motor seal kit
KT-SE1250947
Standard 125 double stack seal kit
KT-SE1250948DS
Standard 125 4-Port seal kit
KT-SE1250948FP

Note!
The above seal kits are applicable to the motors shown in this repair manual. Any special motor may have seals & O-rings unique to that motor.

125 Series Cross Section

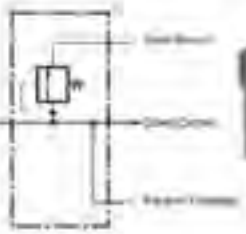


Inlets (2500 psi)

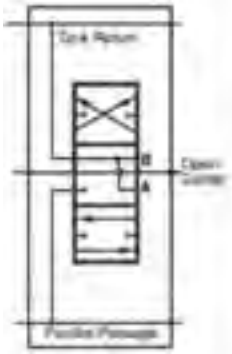
End Inlet

Code	End Port	Top Port
DVA35-A440	1" NPT	1" NPT
DVA35-A880	SAE-16	SAE-16
DVA35-A980	SAE-20	SAE-16
DVA35-A000	NON-PORTED HOUSING	

NOTE: Inlets are machined for a main R/V or R/V plug and are furnished with plastic closures. See Section G, Page 32 for inlet port plugs

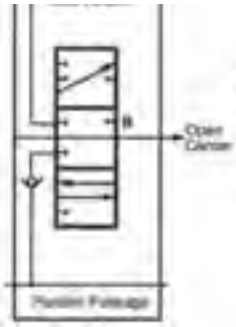


Note: For inlets with solenoid section pilot supply machining, see DVG35 inlet section E1



MA8

Double-Acting Section
4-Way, 3 Position, Float in Neutral
Motor Spool



SA8

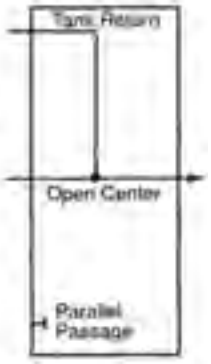
Single-Acting Section
3-Way, 3-Position, Hold in Neutral
Cylinder Spool

Outlets

Tank Return Type

Code	End Port	Top Port
DVA35-TR55	1 1/4" NPT	1 1/4" NPT
DVA35-TR99	SAE-20	SAE-20
DVA35-TR00	NON-PORTED HOUSING	

NOTE: See Section G, Page 32 for Port Plugs



Adjustable Relief Valve Cartridges

For Inlets and Mid-section Inlets

Code	Description
DVA35-MRV-1	Main R/V pressure range 500-2000 psi. Factory set @ 1500 psi @ 50 gpm
DVA35-MRV-2	Main R/V pressure range 2001-2500 psi. Factory set @2500 psi @ 50 gpm
DVA35-MRVP	Main relief valve plug

Lo-Boy Work Sections -- Parallel Circuits

Code	4-Way 2-Position Used to Neutral	3-Way 2-Position Used to Neutral	4-Way 3-Position Float to Neutral	4-Way 3-Position Float Detented	Port Size	Motor Over Center Motorized	Spring Return	3-Position Detent	Solenoid Hydraulic Remote Control	Solenoid Operated	Air Shift		
DVA35-DA0	•					•	•						
DVA35-DA4	•				1"NPT		•						
DVA35-DA8	•				SAE-16		•						
DVA35-SA0		•				•	•						
DVA35-SA4		•			1"NPT		•						
DVA35-SA8		•			SAE-16		•						
DVA35-MA0			•			•	•						
DVA35-MA4			•		1"NPT		•						
DVA35-MA8			•		SAE-16		•						
DVA35-DK8 12V	•				SAE-16					• 12 VDC			
DVA35-DK8-24V	•				SAE-16					• 24 VDC			
DVA35-DX4	•				1"NPT				•				
DVA35-DX8	•				SAE-16				•				
DVA35-DV4	•				1"NPT						•		
DVA35-DV8	•				SAE-16						•		
DVA35-MX4			•		1"NPT				•				
DVA35-MX8			•		SAE-16				•				
DVA35-DB4	•				1"NPT			•					
DVA35-DB8	•				SAE-16			•					
DVA35-SB4		•			1"NPT			•					

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Brief Circuit Descriptions

Series Circuit

Available in DVA20 sections only.

If a machine's work cycle requires simultaneous as well as separate operation of individual hydraulic work functions, a series circuit is right for the job.

As with the other circuits, the oil flows through the open center when all spools are in neutral. There is no parallel passage in stacked series sections because they feed directly from the open center passage. If more than one spool is operated, pump flow goes first to the section closest to the inlet. Return flow from the first section is fed back into the open center for use by downstream sections.

Downstream sections can be series, parallel or tandem and will operate in series with the upstream section.

In series circuits, operating pressure is cumulative. Therefore, the sum of the pressures in the circuits can not exceed the circuit or main relief valve setting.

Parallel Circuits

Parallel circuits are the most common on mobile equipment because more than one function can be operated simultaneously and at random. If two or more functions are fully operated at the same time, the one with the lighted load will assert priority because the fluid will take the path of least resistance. However, the operator can divide the flow between functions by metering the spools.

Movement of the spool meters or shuts off the flow of oil thru the open center passage and pressurizes the parallel passage. Oil is then available at the operator's discretion, to all work ports connected to the parallel passage.

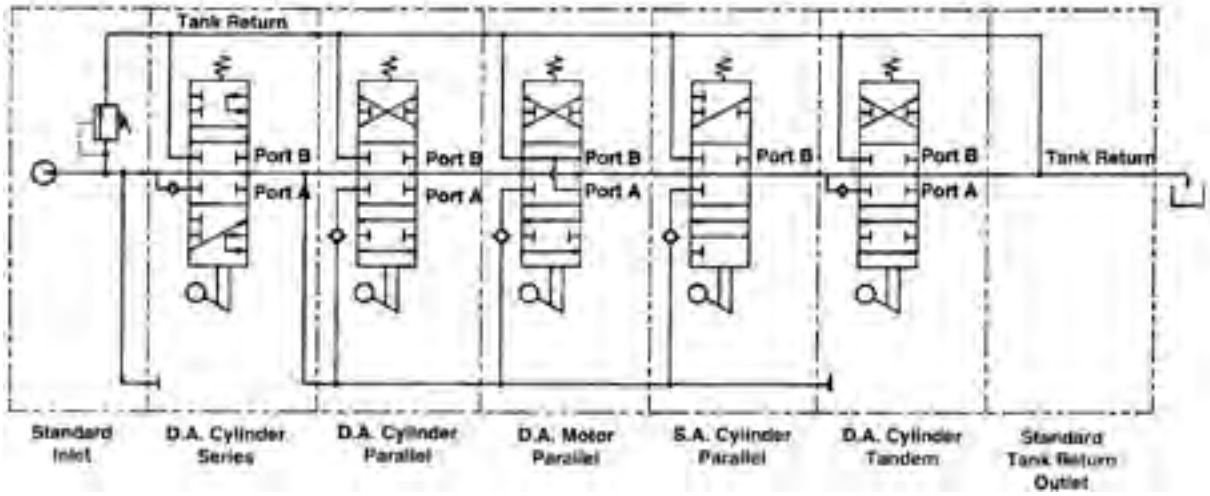
Tandem Circuits

(Not available in the program)

Tandem circuits are sometimes called priority or standard circuits by other manufacturers. Tandem sections feed from the open center passage like series sections but the return flow is directed to the tank return passage and is not available downstream.

If a tandem section is followed by a series or tandem section, operating the tandem section reserves the main will assert priority and downstream sections will not function.

Typical Work Section Schematics



VA™/VG™ Valve Service Instructions

INTRODUCTION

This manual has been prepared to assist you in the proper maintenance of the VA20™/VA35™ and VG20™/VG35™/VG80™ directional control valves. Before any work is done, we suggest that you read the assembly and disassembly instructions completely.

The first rule of good maintenance is cleanliness, which includes a clean environment. MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA. Dirt is the natural enemy of any hydraulic system.

GENERAL INFORMATION

The VA and VG model valves are updated versions of our proven A20™ and A35™ units. The VG models are cast from compacted graphite, a high strength iron alloy, which allows the valve to be rated to 3500 psi. VA models are cast from gray iron and are rated at 2500 psi. These open-center, directional-control valves are available in parallel, tandem, and series circuitry. As needed, the sectional, stack-type construction provides flexibility for the addition of subtraction of work sections to an existing valve bank. This design also permits the combination of parallel, tandem, and series circuitry in a single bank. The internal coring of each valve section determines its circuitry and the number of gasket seals required.

All sections with optional features, such as port relief valves, crossover relief valves, and anti-cavitation checks, are dimensionally larger when measured from the top of the port to the bottom of the housing. These are referred to as "hi-boy" sections. Those without work-port options can use the low-profile castings, which are called "lo-boy" sections.

REPLACEMENT PARTS

The illustrations and instructions in this manual apply only to the VA/VG series assemblies, subassemblies, and components. All valve components, except for spools and housings, are available as replacement parts or subassemblies. Spools are hone-fitted to their individual housings, so damage to either of these components means the entire section must be replaced.

We recommend that you use only genuine VA/VG series replacement parts in your service program. Manufactured to the same exacting tolerances and quality controls as the original equipment, genuine VA/VG replacement parts may help prevent premature, component failure and costly downtime. Service parts and assemblies are available through your original equipment dealer or any authorized distributor.

MAINTENANCE

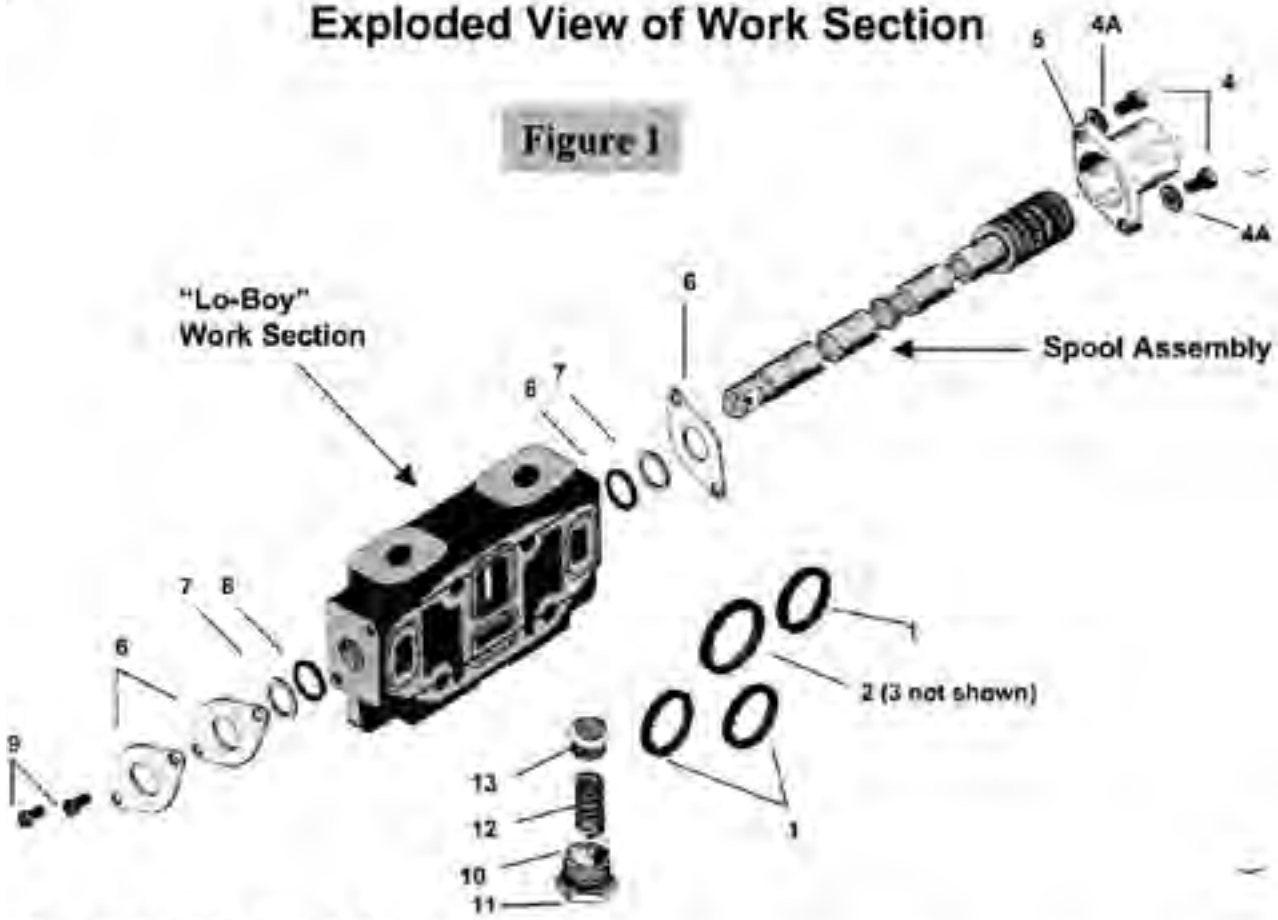
Valves are often used in hazardous environments. Inspect them frequently for damage due to improper use, corrosion or normal wear. If needed, repairs should be made immediately.

Always refer to the machine manual for the proper procedure to remove the valve from the machine.

Remove the valve bank from the equipment, disconnecting all hoses, fittings, control handles and linkage connectors that might be attached to the valve. Plug all ports and thoroughly clean the exterior of the valve bank, then the port plugs can be removed.

Exploded View of Work Section

Figure 1

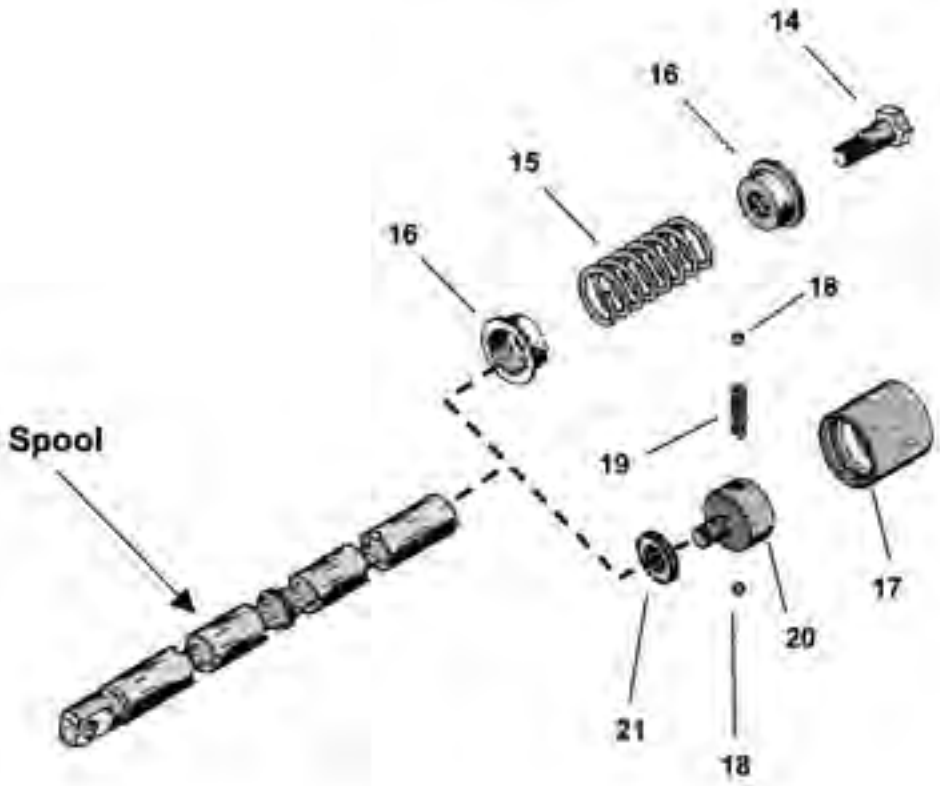


Parts List For Work Section

Item	Description	Qty.	VA/VG20 Part No.	VA/VG35 Part No.	VG60 Part No.
Parallel Section Seals* See Figure 1					
1.	Square Seals	3	391-2881-206	391-2881-200	391-2881-433
2.	Square Seal	1	391-2881-200	391-2881-403	391-2881-670
Series Section Seals					
1.	Square Seals	2	391-2881-206	391-2881-200	.....
3.	Square Seal	1	391-2881-627	391-2881-628	.....
Parallel and Series Section Component Parts. See Figure 1					
4.	Back Cap Screws	2	391-1433-020	391-1433-009	(4) 391-1402-068
4A.	Lock washers	8	.....	.....	391-3783-039
5.	Back Cap	1	341-6000-100	342-6000-100	341-0585-099
6.	Retainer Plates	3	391-2183-001	391-2183-005	391-2183-157
7.	Back up Rings	2	391-2681-378	391-2681-426	391-2681-285
8.	Spool Seals	2	391-1965-014	391-2887-212	391-2681-096
9.	Retainer Plate Screws	2	391-1433-015	391-1433-002	(4) 391-1402-015
10.	Check Valve Cap	1	391-0561-044	391-0561-044	391-0585-099
	Or Valve Cap (F.I.N.)	1	391-2251-015	391-2251-015	.....
11.	O Ring Seal **	1	391-2881-204	391-2881-204	391-2881-249
12.	Check Spring **	1	391-3581-713	391-3581-713	391-3581-775
13.	Check Valve Poppet **	1	391-2481-069	391-2481-069	391-2383-091

*Parallel Sealing Face Includes inlets and mid-inlets.
**Not required in Float-in-neutral Sections.

Figure 2



Spring Centered and Detent Spool Operators. See Figure 2

14.Stripper Bolt	1	391-1432-022	391-1432-021	391-1402-452
15.Centering Spring	1	391-3581-608	391-3581-633	391-3581-330
16.Spring Guides	2	391-1642-045	391-1642-013	391-1642-161
17.Detent Sleeve	1	391-3283-015	391-3283-008	391-3384-310
18.Detent Balls	2	391-0282-010	391-0282-009	391-0282-011
19.Detent Spring	1	391-3581-130	391-3581-015	391-3581-316
20.Detent Poppet Retainer	1	391-2583-008	391-2583-006	391-3384-311
21.Detent Spacer	1			391-3782-208

4

Valve Disassembly Instructions

Reference exploded view and parts list on page 2 and 3 for work section detail.

Step 1 - Valve Bank

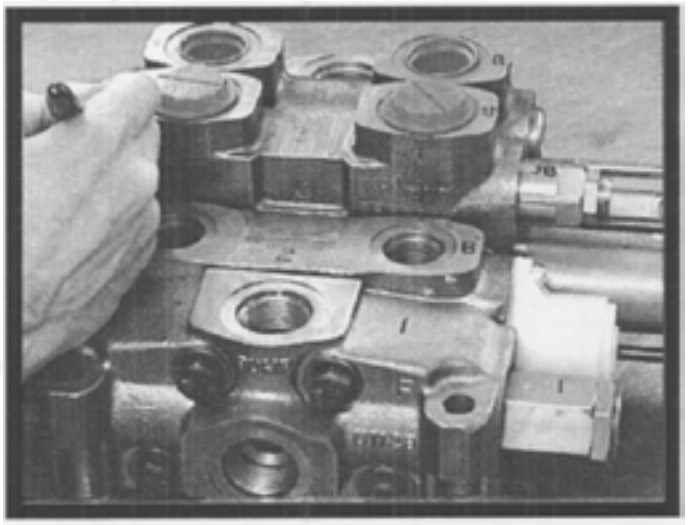
This step is the most critical in the disassembly procedure. It should be followed closely to ensure that the valve bank is properly reassembled after repairs have been made.

With a waterproof, quick-drying marker, mark each casting with a sequential number. Start by marking the inlet casting with the #1 and finish by marking the outlet with the highest number.

Next, mark the port boss closest to the back cap on each work section with a "B" (for back cap end).

Then, mark the port boss closest to the spool clevis on each work section with a "C" (for clevis end).

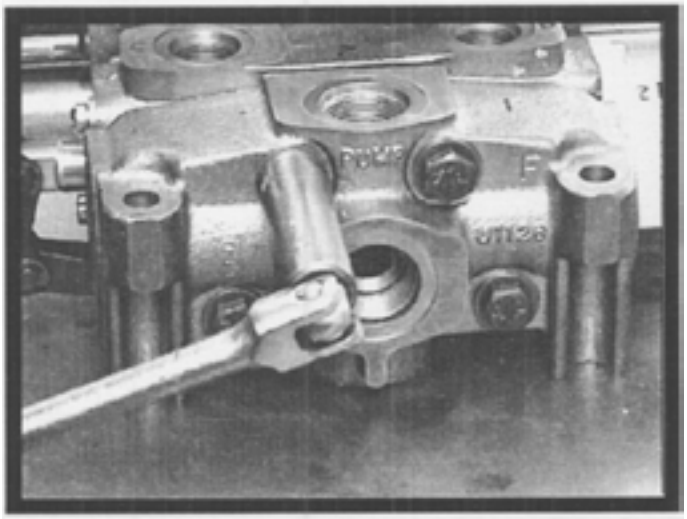
Finally, if relief valves are removed from the valve bank they must be marked with the corresponding number of the casting and port location (B or C) from which they were removed. Inlet and mid-inlet relief valves are marked with a casting number only.



Step 2 - Tie Bolts

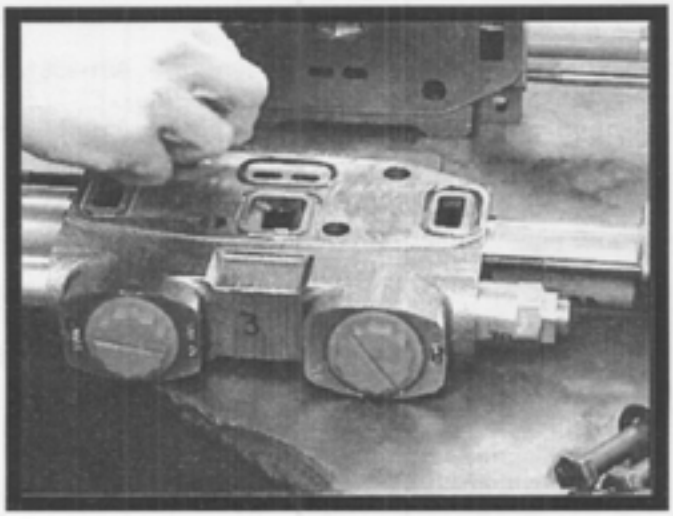
Remove the four, tie bolts that hold the bank together and separate the sections.

NOTE: VA valve tie bolts thread into the outlet casting. VG valve tie bolts pass through the entire bank, requiring washers and hex nuts to be fastened at both ends of the bolt.



Step 3 - Section Seals

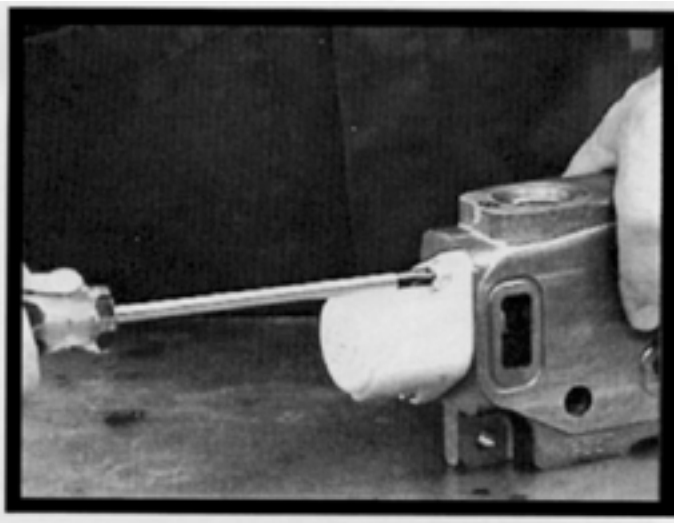
The inlet, mid-inlet and each parallel work section have four, section seals, (Fig. 1, items 1 & 2) on the downstream, mating face. Series work sections and the VA/VG35 split flow mid inlets have three section seals on the downstream mating face, (Fig. 1, items 1 & 2.) These section seals should be removed and discarded.



REMINDER: ALL WORK MUST BE PERFORMED IN A CLEAN AREA.

Valve Disassembly Instructions

5



Step 4 - Valve Back Cap

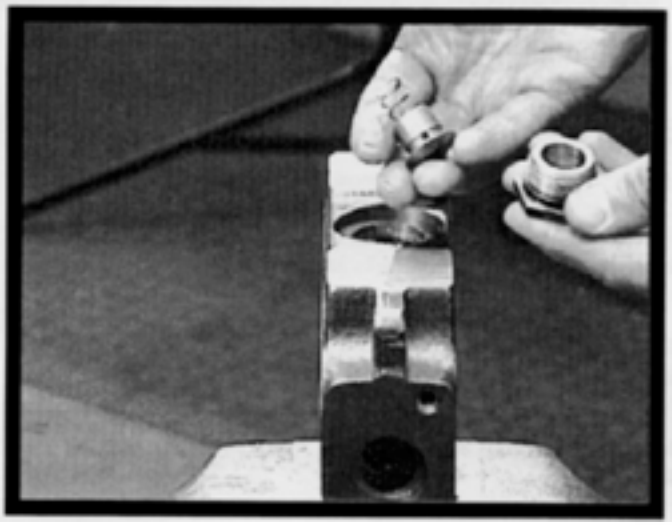
Using a large, Phillips-head screwdriver, remove the two, cap screws (Fig. 1, item 4) which fasten the back cap to the work section. Lightly tap the end of the screwdriver handle with a hammer to break adhesive. Remove the back cap (Fig. 1, item 5).

Step 5 - Control Spool and Seals

Grasp the spring end of the spool with a clean, lint-free cloth and pull the spool out of the housing using a twisting motion. Generally, the rear, retainer plate (Fig. 1, item 6) back-up ring (Fig. 1, item 7) and spool seal (Fig. 1, item 8) will come out with the spool.

CAUTION: For detented spool models, be careful not to remove the detent poppet sleeve (Fig. 2, item 17) unless it is to be serviced.

Using a large, Phillips-head screwdriver, remove the two, retainer-plate screws (Fig. 1, item 9) from the spool clevis end of the work section. Lightly tap the end of the screwdriver handle with a hammer to break the adhesive. Remove the two, retainer plates (Fig. 1, item 6) the back-up ring (Fig. 1, item 7) and the spool seal (Fig. 1, item 8). Tag or mark with the appropriate, work section identification number. (See Step 1.) Spool seals (Fig. 1, item 8) and back-up rings (Fig. 1, item 7) should be discarded.



Step 6 - Transition Check

The transition check is located in the bottom center of the work section housing. Carefully clamp the work section in a vise with ports down. Do not clamp on the machined surface. Remove the check-valve cap (Fig. 1, item 10) and its O-ring seal (Fig. 1, item 11). Discard the seal. Remove the check spring (Fig. 1, item 12,) and the check-valve poppet (Fig. 1, item 13).

NOTE: Only cylinder work sections (ports blocked in neutral) have a transition check. Motor sections have only a cap plug.

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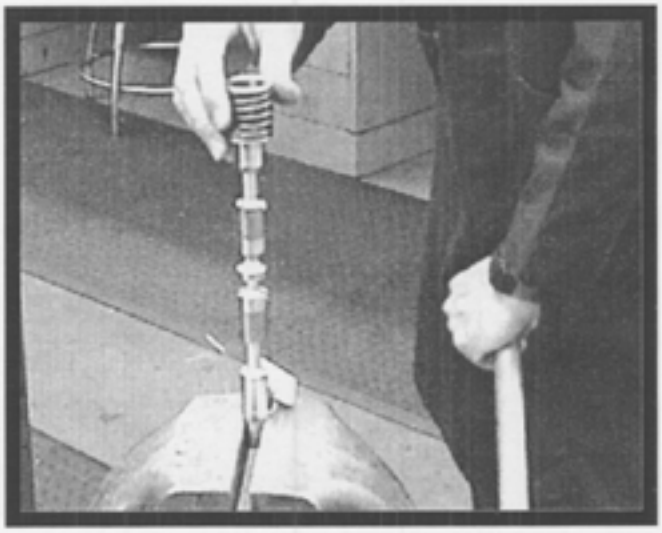
6

Valve Disassembly Instructions

Spool Disassembly

Spring Centered Spool

The spring assembly should not be removed from the spool unless these parts need to be replaced. Once the spool is free of the work section housing, it must be handled carefully to avoid damage. Place the spool vertically in a soft-jawed vise, clamping on the flat, spool clevis, and remove the stripper bolt (Fig. 1, item 14) with a wrench.



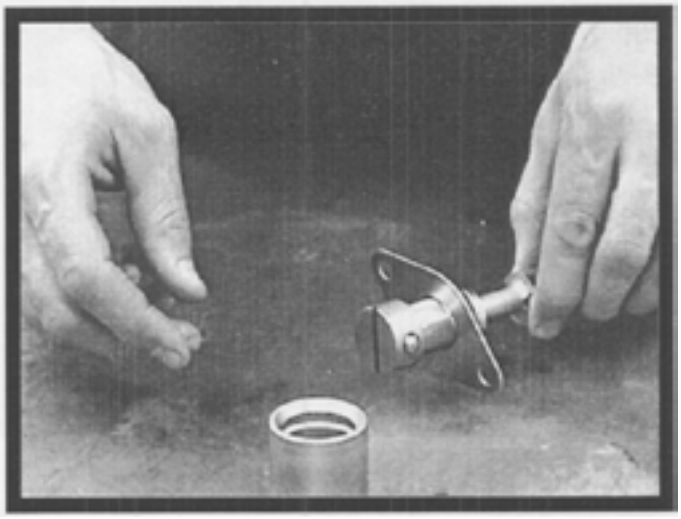
Lightly tap the stripper bolt with a hammer and a punch to help break the adhesive. Cautious application of heat may be required to free the stripper bolt, since an anaerobic thread adhesive was used during its assembly.

CAUTION: Too much heat may distort the spool.

As the stripper-bolt threads disengage, the spring (Fig. 2, item 15) and spring guides (Fig. 2, item 16) will release abruptly from the spool.

Detent Spool

The detent assembly should not be removed from the spool unless these parts need to be replaced. Wrap the detent sleeve (Fig. 2, item 17) with a clean, lint-free cloth. Grip the cloth-covered sleeve and pull firmly. As the sleeve moves backwards, the detent balls (Fig. 2, item 18) and the detent spring (Fig. 2, item 19) will release abruptly. The cloth should capture these parts and prevent their loss.



Next, clamp the spool in a soft-jawed vise and remove the detent poppet retainer (Fig. 2, item 20). Place an undersized bar through the detent ball bore to serve as a wrench. Lightly tap the detent poppet retainer with a hammer and a punch to help break the adhesive. Cautious application of heat may be required again, since an anaerobic adhesive was also used in the detent retainer assembly.

CAUTION: Too much heat may distort the spool!

CLEANING, INSPECTION, AND REPAIR

1. Inspect the spool bore, transition check seat and spool from each section for deep scratches, gouges or excessive wear. If any of these conditions exist, replace the section. Minor, surface damage on the control spool and check poppet can be carefully polished away with a very fine, emery cloth.

2. Examine the machined surfaces of the valve housing for nicks and burrs that could cause leakage between sections. Lightly stone these surfaces to remove any rough spots.

CAUTION: A shallow-milled relief area extends across the O-ring face of the valve housing. This should not be stoned or ground off!

3. Wash all parts thoroughly in a cleaning solvent and blow dry before beginning reassembly. Pay special attention to the number and letters marked on the parts in Step 1. If any marks are removed during cleaning, remark immediately.

4. Clean adhesive from threads of spool, stripper bolt, housing, cap screws and hex nut with Loctite™ Chisel Gasket Remover.

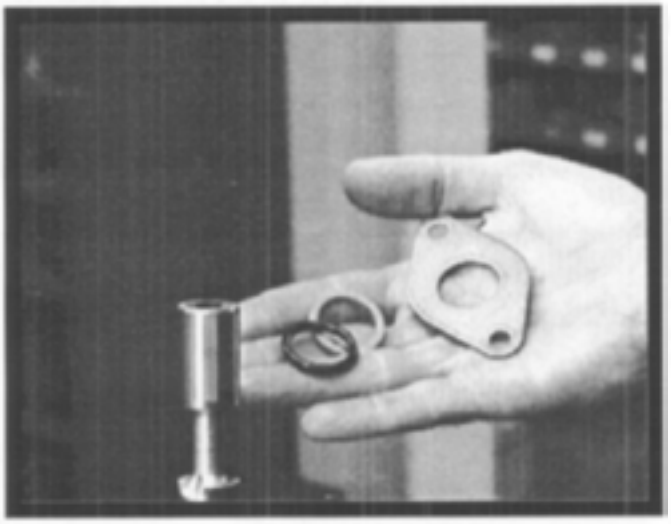
Valve Assembly Instructions

Preparation of Parts

Spray the threads of the new stripper bolt (Fig. 2, item 14) tapped-threaded spool end, all screws and screw holes on both ends of the housing with LOCQUIC Primer Grade NF™ and let dry.

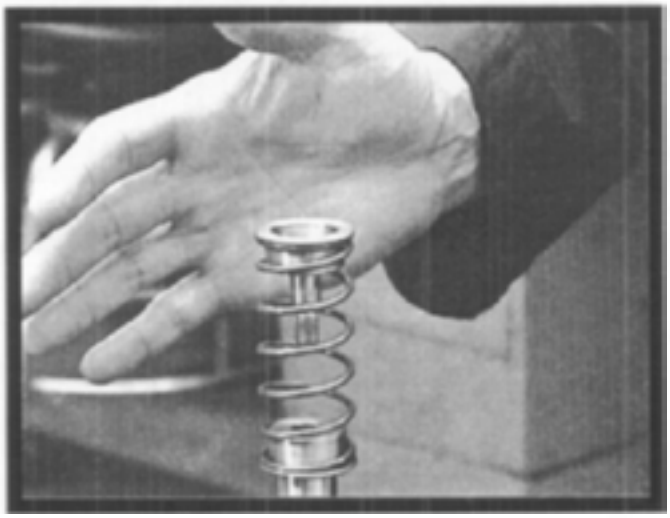
CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is placed back into service.

Spring Center Spool Assembly



Step 1 - Spool Assembly-Spring Centered

Clamp the flat, clevis end of the control spool in a soft jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the end of the spool away from the clevis. Slide on the back-up ring (Fig. 1, item 7) and retainer plate (Fig. 1, item 6). Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches



Step 2 - Attach Spring Guides and Spring

Apply 2 - 3 drops of Locrite 262™ or equivalent anaerobic adhesive near the middle of the female threads in the spool. Assemble the spring guides (Fig. 2, item 16) centering spring (Fig. 2, item 15) and stripper bolt (Fig.2, item 14,) onto the spool (Reverse of Step 7) Torque the stripper bolt to 175 in. lbs. +/-4 in. lbs.

CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding. Check for binding by compressing the spring and guides or by rotating the spring guide nearest the housing.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure!

Lightly coat the centering spring with high- temperature grease to prevent rusting. Set the spool assembly aside and let it cure for a minimum of 1 hour. After curing, test the stripper bolt to make certain it can withstand 125 in. lbs. of breakaway torque.

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Valve Assembly Instructions

Detent Spool Assembly

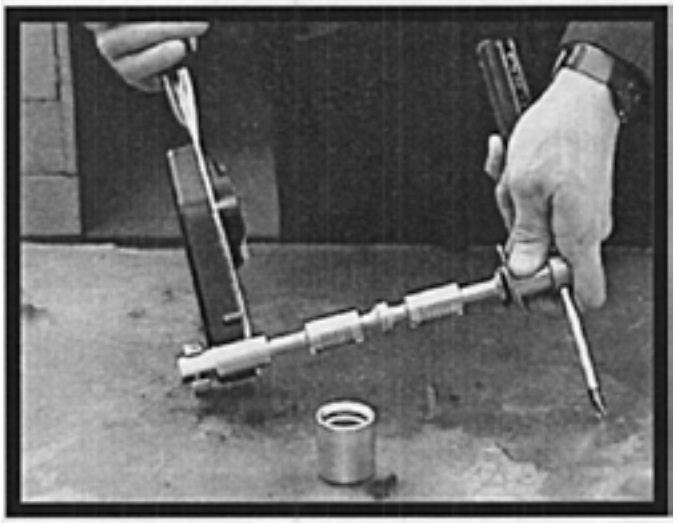
Step 1 - Spool Assembly-Detent

Apply Parker Super O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide the back-up ring (Fig. 1, item 7) and one retainer plate (Fig. 1 item 6) onto the spool. Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches. Apply 2 – 3 drops of Loctite 262™ or an equivalent, anaerobic adhesive near the middle of the female threads in the spool.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure.

Step 2 - Spool Assembly-Detent

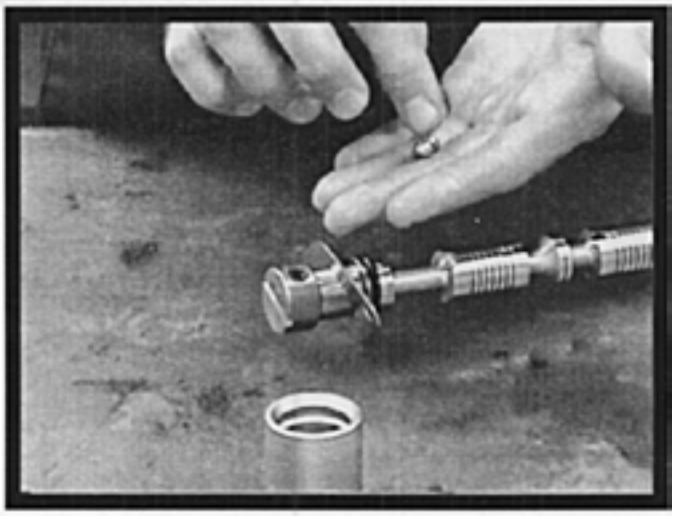
Thread the detent ball retainer (Fig. 2, item 20) into the spool end. Torque the detent ball retainer to 175 in. lbs. (+/-4 in. lbs.). This can be accomplished by using a crows-foot socket on the flats of the clevis, and holding the spool by inserting a round, steel rod or screwdriver through the hole in the ball retainer.



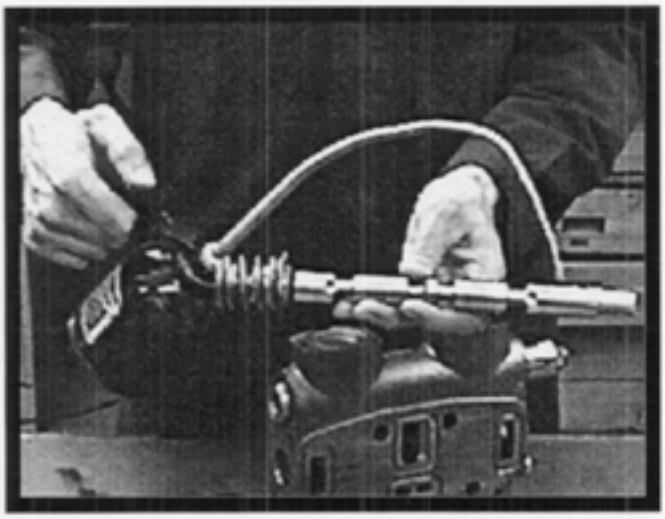
Step 3 - Detent Balls and Spring

Next, lightly coat the detent balls (Fig. 2, item 18) detent spring (Fig. 2, item 19) and entire inside diameter of the detent sleeve (Fig. 2, item 17) with high-temperature grease.

Insert the detent spring into the through hole in the detent ball retainer. Place the steel balls on the ends of the spring. Compress the balls and spring, then slip on the detent sleeve. (Note: The detent sleeve is not symmetrical; one end of the sleeve has a lead-in chamfer. This chamfer must face the spool clevis when assembled.) Move the detent sleeve to the neutral or middle position to prevent the subassembly from separating during subsequent steps.



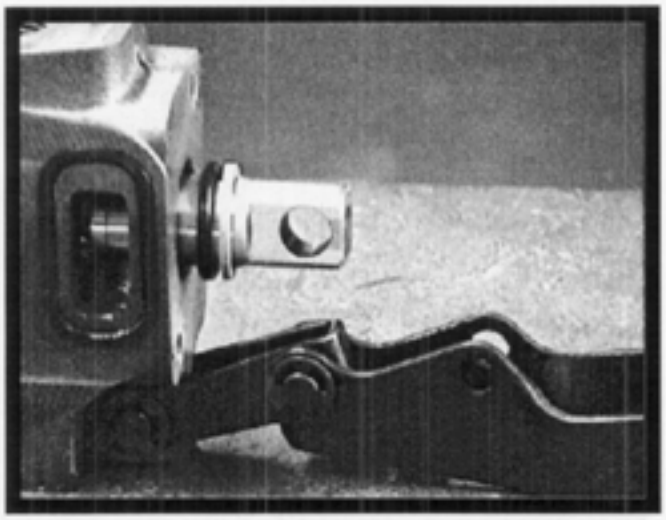
Valve Assembly Instructions



Step 1 - Spool Subassembly

Apply 2 - 3 drops of Loctite 262™ or equivalent to the fillester screw holes on both ends of the housing.

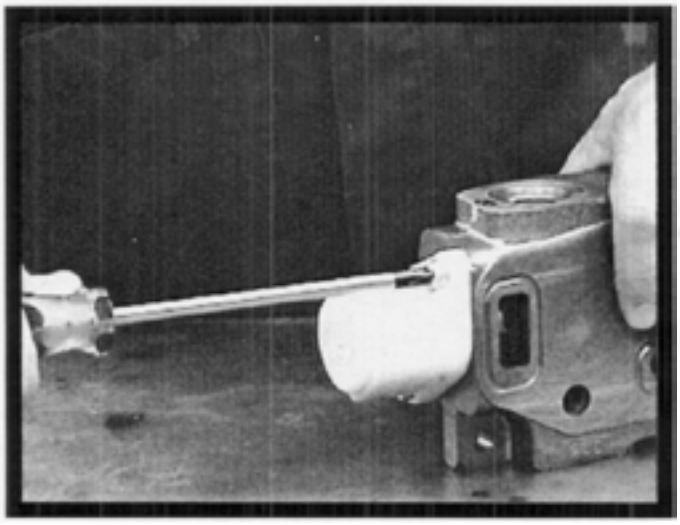
Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool assembly into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage the seals. Make sure that the spool and housing are in the proper orientation (see Step 1, page 6 disassembly).



Step 2 - Spool Seal and Back up

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide on the back-up ring (Fig. 1, item 7). Push both items into the counter-bore until they bottom out.

Assemble the two, front retainer plates (Fig. 1, item 6) using the two short, fillester screws (Fig. 1, item 9). Check retainer plates for proper alignment. Tighten to a final torque of 34 in. lbs. +/-2 in. lbs.



Step 3 - Back cap

Install the back cap using the two, long, fillester screws (Fig. 1, item 6). Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.

Caution: Excessive torque will damage the back cap ears!

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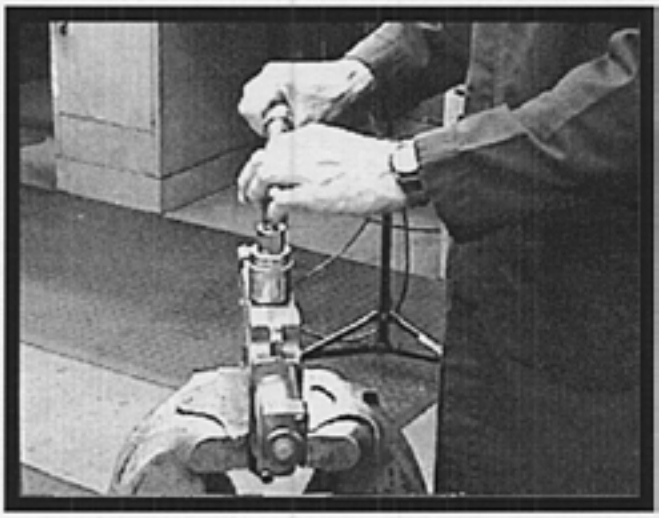
Valve Assembly Instructions

Step 4 - Install Transition Check

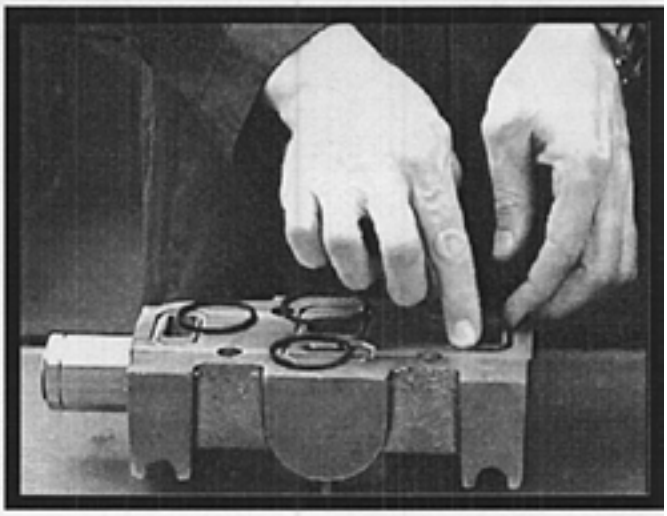
Inspect transition check components for cleanliness. Install check poppet (Fig. 1, item 13) into the transition check cavity. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 11) over the poppet and spring. Turning by hand, engage several threads. Tighten to a final torque of 75 ft. lbs. +/-4ft. lbs.



Step 5 - Relief Valves

Return all relief valves to their proper positions and torque to 75 ft. lbs.

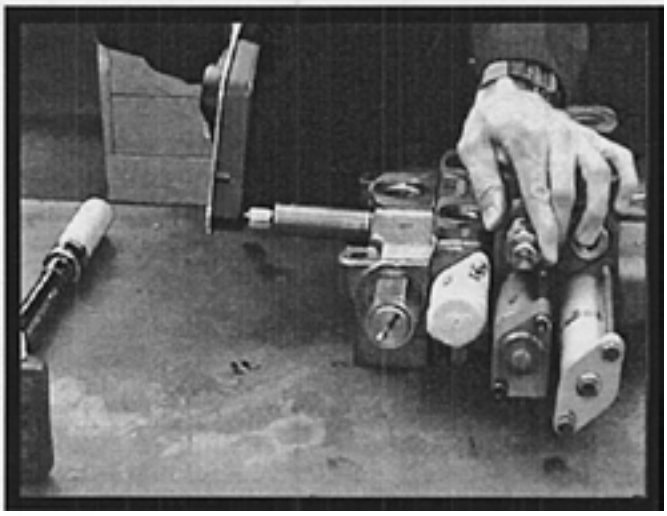
Install new, section seals. Place section seals (Fig. 1, items 1 & 2, or items 1 & 3) in the proper grooves. Make certain seals stay in their grooves during assembly.



Step 6 - Install Tie Bolts

Slide the tie bolts through the inlet casting. If cap screws are used, place a washer on the cap screw prior to installation. Place the valve sections on the tie bolts in their proper sequence (see Step 1, page 9). Turning by hand, engage several threads in the outlet. If it is a VG series assembly, assemble nut and washer to either end of the stud and follow above instructions. Torque the tie bolts in a cross-corner pattern.

Tie Bolt Torque Values
VA20 - 29 ft. lbs. (348 in. lbs.)
VG20 - 42 ft. lbs. (504 in. lbs.)
VA35 - 34 ft. lbs. (408 in. lbs.)
VG35 - 75 ft. lbs. (900 in. lbs.)
VG80 - 150 ft. lbs. (1800 in. lbs.)



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Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks between sections	Pinched, blown or missing section seal	Replace section seal
	Stud fasteners not correctly torqued	Replace section seals and re-torque
	Mounting plate not level	Loosen mounting bolts and shim as required
	Contamination/burrs on seal	Clean seal groove, replace section seal
Oil leaks at either end of spool	Over-pressurized tank core	Correct high, back-pressure condition
	Worn or damaged spool seals	Replace seals and seal retainers
Spring - centered spools do not return to neutral	Broken centering spring	Replace centering spring
	Misalignment of operating linkage	Check linkage for mechanical binding
	Foreign particles in system	Clean valve and system
Load will not hold	Cylinder leaking or worn	Check cylinder - repair
	Port relief valve not holding	Remove and clean or replace
	Spool or housing scored or worn excessively	Replace section
Load drops when spool moved from neutral	Dirt or foreign particles lodged between check-valve poppet and seat	Disassemble, clean & reassemble
	Scored or sticking check-valve poppet	Replace poppet
No motion, slow, or erratic system operation	Worn pump	Check flow & pressure
	Defective cylinder or motor	Repair or replace
	Low-reservoir oil level	Add oil to specifications
	Clogged suction strainer	Clean or replace
	Suction line restricted	Check lines
	Relief valve not properly set	Check pressure setting
	Relief valve poppet or seat scored & sticking open	Replace relief valve
	Valve spool not shifted to full stroke	Check spool linkage travel